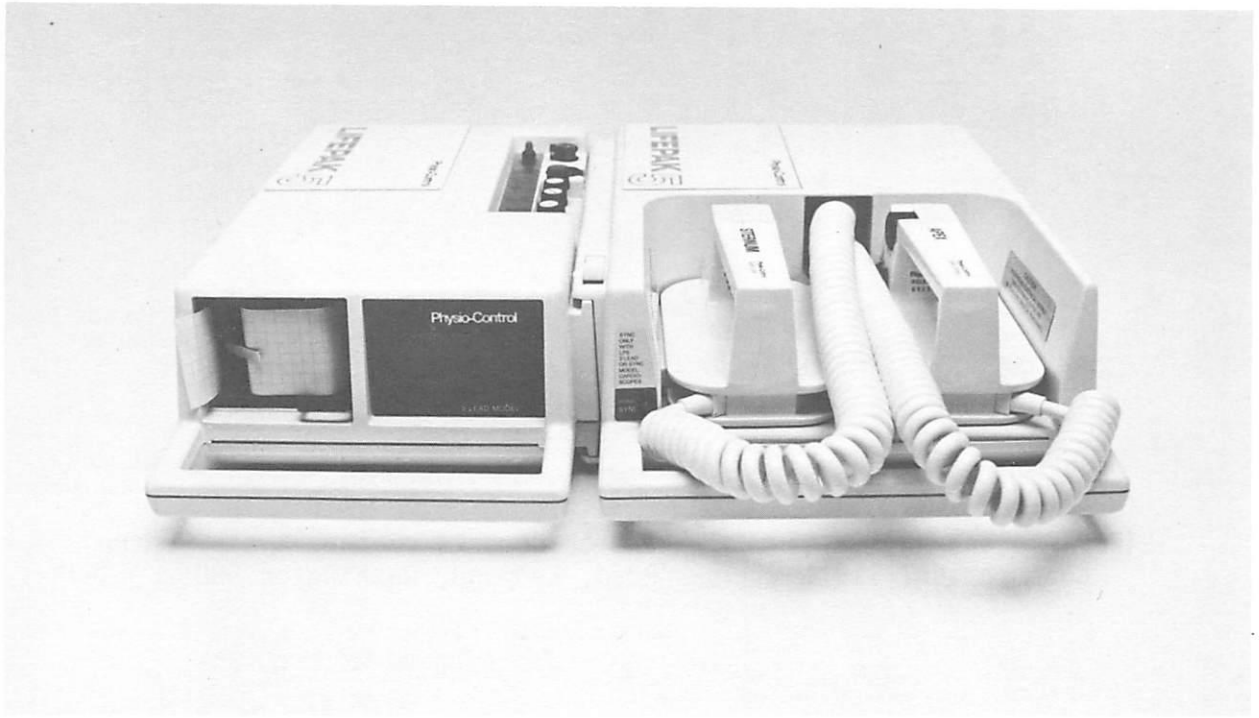

LIFEPAK® 5

Cardiac Care System

Operating and Service Manual

Manual No. 09-10427-07

October 1982

PHYSIO CONTROL

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HOW TO USE THIS MANUAL.

Section I of the manual provides introductory information with FUNCTIONAL DESCRIPTIONS and GENERAL SPECIFICATIONS.

Section II informs the authorized user how to OPERATE THE EQUIPMENT, identifies various CONTROLS AND INDICATORS, and gives simple SERVICING INSTRUCTIONS.

Section III gives detailed TECHNICAL OPERATION and circuit descriptions, accompanied by schematic drawings, helpful in understanding the high-technology electronic designs.

Section IV consists of MAINTENANCE PROCEDURES and test data which assist in TROUBLESHOOTING the equipment. DISASSEMBLY PROCEDURES are also described.

Section V contains ILLUSTRATED PARTS LISTS with EXPLODED VIEWS to help identify replaceable parts by number and location.

Section VI is a folio of useful SCHEMATIC DRAWINGS which are updated periodically, as well as useful connector pin-outs and interconnect information. We believe this compendium of information will be helpful to maintenance staff, and others.

SECTION 1
INTRODUCTION

1-1. SCOPE

This manual provides the operating and service procedures for the LIFEPAK 5 ECG Monitor/Recorder and DC Defibrillator units manufactured by Physio-Control Corporation, Redmond, Washington.

The six sections of the manual provide Introductory, Physical and Functional Descriptions; Operating Procedures; Circuit Description; Maintenance Procedures; Illustrated Parts Lists; and Schematic Drawings.

Differences In The Various Models Of LIFEPAK 5 Equipment

ECG Monitor/Recorder p/n 09-00283-14 Domestic, C/R, ENG., CLA, 60Hz Filter.
ECG Monitor/Recorder p/n 09-00283-15 No C/R, ENG., CSA, 60Hz Filter.
ECG Monitor/Recorder p/n 09-00283-16 No C/R, ENG., TUV, 50Hz Filter.
ECG Monitor/Recorder p/n 09-00283-17 C/R, ENG., CSA, 60Hz, Filter.
ECG Monitor/Recorder p/n 801529-00 No C/R, FR., CSA, 60Hz, Filter.
ECG Monitor/Recorder p/n 801529-02 No C/R, GR., TUV, 50Hz, Filter.
ECG Monitor/Recorder p/n 801529-06 No C/R, FR., 50Hz, Filter.
ECG Monitor/Recorder p/n 801529-07 No C/R, SP., 50Hz, Filter.
ECG Monitor/Recorder p/n 801529-08 No C/R, SP., 60Hz, Filter.
ECG Monitor/Recorder p/n 801529-09 C/R,FR., CSA, 60Hz, Filter.
LIFEPAK 5 Defibrillator p/n 09-00285-08 Domestic, 360J.
LIFEPAK 5 Defibrillator p/n 09-00285-11 ENG., TUV, 360J.
LIFEPAK 5 Defibrillator p/n 09-00285-12 ENG., CSA, 360J.
LIFEPAK 5 Defibrillator p/n 801528-00 FR., CSA, 360J.
LIFEPAK 5 Defibrillator p/n 801528-02 GR., TUV, 360J.
LIFEPAK 5 Defibrillator p/n 801528-04 FR., TUV, 360J.
LIFEPAK 5 Defibrillator p/n 801528-05 SP., TUV, 360J.
LIFEPAK 5 Battery Charger p/n 09-00284-09 STANDARD, ENG., CSA/UL/CLA, 115V.
LIFEPAK 5 Battery Charger p/n 09-00288-08 STANDARD, ENG., 220V.
LIFEPAK 5 Battery Charger p/n 09-00288-10 GR., TUV, 220V.
LIFEPAK 5 Battery Charger p/n 801530-00 FR., CSA, 115V.
LIFEPAK 5 Battery Charger p/n 801530-01 FR., 220V.
LIFEPAK 5 Battery Charger p/n 801530-02 GR., 220V.
LIFEPAK 5 Battery Charger p/n 801530-03 SP., 220V.
LIFEPAK 5 Battery Charger p/n 801530-04 SP., 115V.

Abbreviations used above are:

C/R: Has provisions for use with the ECG/Voice Recorder p/n 801595.
ENG.: English Language Labels.
FR.: French Language Labels.
GR.: German Language Labels.
SP.: Spanish Language Labels.
CSA: Meets Canadian Standards Association requirements.
CLA: Meets City of Los Angeles requirements.
TUV: Meets Technischer Uberwachungs-Verein (W. German) requirements.
50Hz Filter: Ambient 50Hz interference notch filter.
60Hz Filter: Ambient 60Hz interference notch filter.

1-2. PHYSICAL DESCRIPTION

The following paragraphs provide a brief physical description of the ECG Monitor/Recorder and DC Defibrillator units plus accessory equipment available. Figure 1-1 shows the LIFEPAK 5, ECG Monitor/Recorder unit, DC Defibrillator unit, Battery/Pak, and optional Battery Charger. Table 1-1 lists the general specifications for LIFEPAK 5.

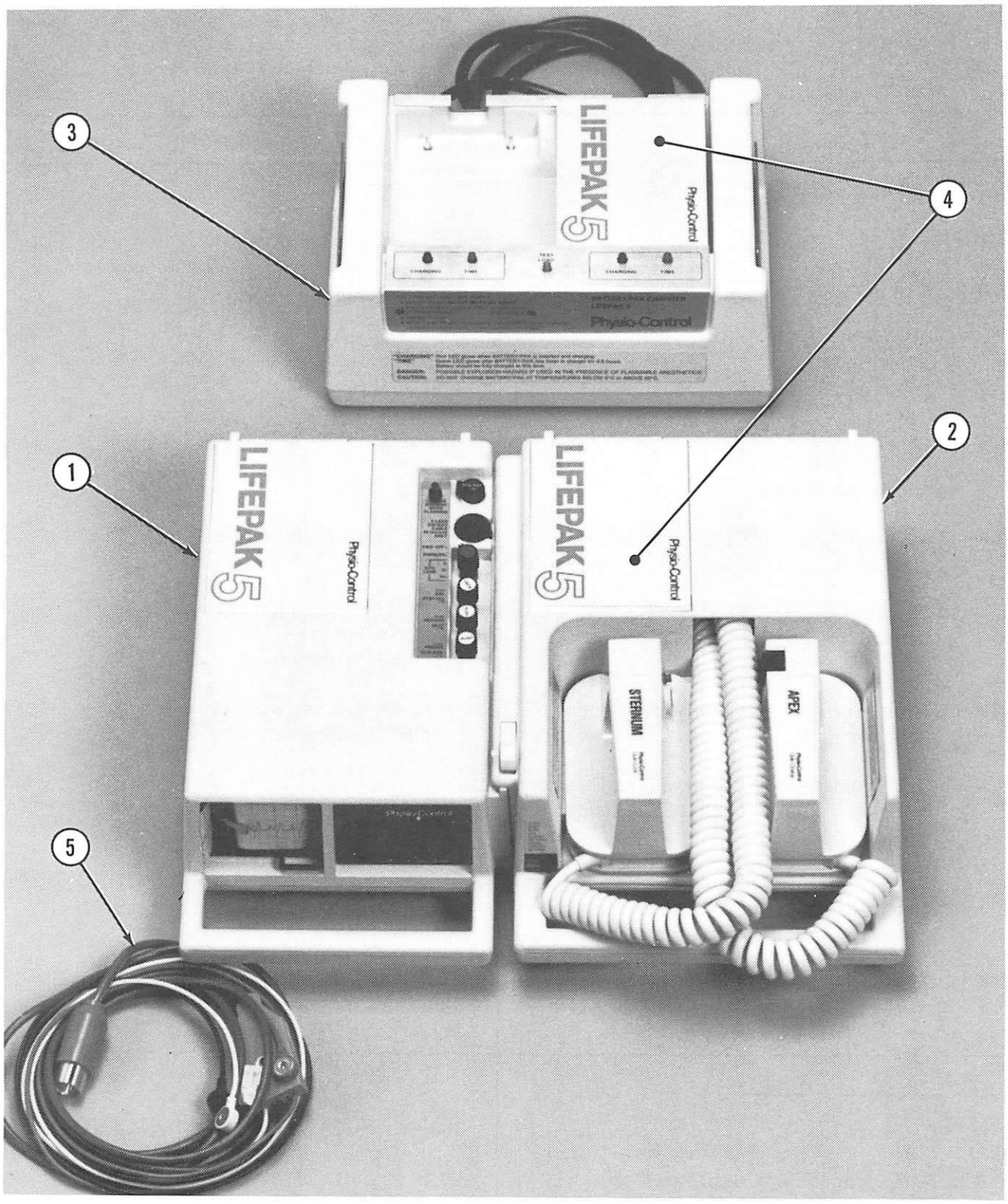
1-3. General. LIFEPAK 5 is a precision, portable, battery operated electronic instrument of a modular design. LIFEPAK 5 consists of two units: a ECG Monitor/Recorder unit and a DC Defibrillator unit. Each unit may be operated independent of the other as a unit. Battery/Paks and a Battery Charger, also of a modular design, are required to support the ECG Monitor/Recorder and DC Defibrillator units.

The ECG Monitor/Recorder unit is connected to the DC Defibrillator unit through a special slide connector. They may be separated by pressing the lock release button on the slide. When joined, the two units provide a lightweight combination providing the ultimate in portability and versatility.

The LIFEPAK 5 ECG Monitor/Recorder and DC Defibrillator units are never connected to AC line power. Instead, the rechargeable Battery/Paks are exchanged with fresh Battery/Paks from the Battery Charger. A drained Battery/Pak can be replaced in a matter of seconds. The Battery Charger also contains a test load for regular operational testing of the DC Defibrillator unit.

1-4. ECG Monitor/Recorder Unit. The ECG Monitor/Recorder provides a means of rapidly assessing the patient's condition in a non-hospital environment such as paramedics may encounter. Because of the ECG Monitor/Recorder's small size and weight, it may be easily placed on the patient's stretcher for continuous monitoring while transporting a patient. The ECG Monitor/Recorder provides a continuous no-fade display through either a CRT for real time monitoring or through a delayed recorder display allowing the user to obtain a hard copy of the information displayed on the CRT. When the FREEZE (Push) control is operated, the image on the CRT is held to permit inspection, and the Recorder runs in real time. When the FREEZE condition is released, the Recorder reverts to a three-second delay.

1-5. DC Defibrillator Unit. The Defibrillator provides the means to deliver a controlled monophasic defibrillating pulse to the patient's heart. The paddles provided with the unit may be used either to monitor the patient's ECG signal, when used in conjunction with the ECG Monitor/Recorder, or to deliver the defibrillating pulse. Operation of the DC Defibrillator unit is accomplished entirely through controls mounted on the paddles. This provides the user with a greater flexibility, helping to eliminate the dependency on other personnel. The paddles provided with LIFEPAK 5 are repairable.



1. ECG MONITOR/RECORDER
2. DC DEFIBRILLATOR
3. BATTERY CHARGER
4. BATTERY/PAK
5. PATIENT CABLE

FIGURE 1-1. LIFEPAK 5

TABLE 1-1.

LIFEPAK 5 GENERAL SPECIFICATIONS

CHARACTERISTIC	*QUANTITY OR SPECIFICATION
ECG MONITOR/RECORDER UNIT:	
● SIZE (Envelope).	3.8x7.5x13.3 inches (9.7x19.1x33.8cm).
● WEIGHT (including Battery/Pak) . . .	8.25 pounds (3.7kg).
● ECG MONITOR DISPLAY.	60 x 36mm.
Sweep Speed.	25mm/sec ±1mm.
Bandwidth (3dB).	0.5 to 40Hz.
● RECORDER DISPLAY	40mm.
Sweep Speed.	25mm/sec ±0.75mm.
Bandwidth (3dB).	0.5 to 40Hz.
● ECG OUTPUT	1V/mV (optional 1mV/mV).
Bandwidth.	0.1 to 40Hz.
● POWER SOURCE (Battery/Pak) . . . . . (see below also)	Nickel Cadmium Battery, 12Vdc, 1AH.
ECG Monitor monitoring	1.7 hour minimum at -10°C.
ECG Monitor monitoring in conjunction with 10 minutes of Recorder monitoring.	1 hour minimum at -10°C.
● INPUT: Obtained through 3-lead (six lead connector) patient cable or paddles.	Patient Cable 10 feet (3m) plus 3 feet (0.9m) with leads.
Common Mode Rejection (to chassis ground with 5KΩ misbalance). . . .	80dB minimum.
● LOW BATTERY INDICATOR (flashes when battery is low).	Terminal voltage of 10.2 nominally at 25°C.
DC DEFIBRILLATOR UNIT:	
● SIZE (envelope).	3.8x9.2x13.3 inches (9.7x23.4x33.8cm).
● WEIGHT (including Battery Pak) . . .	10.6 pounds (4.8kg).
● WAVEFORM	Monophasic Pulse, 5ms (Edmark).
● OUTPUT ENERGIES (delivered).	20,50,100,200,300,360 joules ±10%.

TABLE 1-1. (Continued)

LIFEPAK 5 GENERAL SPECIFICATIONS

CHARACTERISTIC	*QUANTITY OR SPECIFICATION
DC DEFIBRILLATOR UNIT (Continued)	
● CHARGE TIME TO 300 JOULES.	10 seconds.
● CHARGE TIME TO 360 JOULES.	12.5 seconds.
● ENERGY BLEED DOWN AFTER 30 SECONDS .	15% maximum.
● BATTERY TEST INDICATOR (flashes when down to)	Terminal voltage of 10.2 nominally at 25°C.
● OUTPUT PADDLES:	
Size	$82cm^2$.
Coil cord length	(2.3m) (7.5 feet).
● POWER SOURCE (Battery/Pak)	Nickel Cadmium Battery, 12Vdc, 1AH.
Capability (see below also). . . .	12 300-joule discharges minimum at -10°C. 32 360-joule discharges minimum at +25°C.
● DEFIBRILLATOR SYNCHRONIZER Synchronized defibrillating pulse for elective cardioversion timed to occur on the down slope of the first patient-generated R-wave which follows defibrillate command.	
Sync Indicator	Intensification marker on CRT trace identifies sync trigger point.
Sensitivity Control.	ECG size control acts as threshold control.
Sync-Defib Mode Control.	Pushbutton switch can be depressed to change mode instantly from Sync to Defib or Defib to Sync.
ACCESSORIES:	
● BATTERY/PAK.	Nickel Cadmium.
Size (envelope).	1.1x3.7x5.4 inches (2.8x9.4x13.7cm).
Weight	1.3 pounds (0.6kg).
Output	12Vdc, 1AH.
● BATTERY CHARGER:	
Size (envelope).	4.3x11.3x8.3 inches (10.9x28.7x21.1cm).
Weight	5.25 pounds (2.4kg).
Power Source	115V, 50-60Hz; 230V, 50-60Hz; or 11-15Vdc. (max. input power 30W).

TABLE 1-1. (Continued)

LIFEPAK 5 GENERAL SPECIFICATIONS

CHARACTERISTIC	*QUANTITY OR SPECIFICATION
ACCESSORIES (Continued)	
Recharge Time (two Battery/Paks charged simultaneously) at 25°C Test Load.	4-5 hours. 50Ω ±5Ω.
● BATTERY SUPPORT SYSTEM (OPTION)	All specifications are available in the LP/5 Battery Support System Operating and Service Manual p/n 802065.
● ECG/VOICE RECORDER (OPTION)	All specifications are available in the LP/5 ECG/Voice Recorder Operating and Service Manual p/n 801945.
ENVIRONMENTAL CONDITIONS :	
Unless otherwise stated the performance requirements of LIFEPAK 5 shall be met under the following storage and operating conditions. (Both units, excluding Battery Charger).	
● TEMPERATURE RANGE.	-10°C to +55°C (operating), -35°C to +65°C (storage).
● ATMOSPHERIC PRESSURE	525mmHg to 800mmHg.
● RELATIVE HUMIDITY.	0 to 95%.
● VIBRATION (capable of meeting after vibration)	MIL-STD-810C Method 514.2 curve V.
● SHOCK (capable of meeting after shock)	MIL-STD-810C Method 516.2 Procedure 1, Figure 516.2-2.
● SPLASH TEST (capable of meeting after splash, excluding paper recorder).	MIL-STD-108E, Paragraph 4.9.
● DROP (without resulting in operator or patient hazard during drop) . .	1.5 foot (45.7cm) drop on a concrete floor on each axis (6 drops).
● TELEMETRY (operate with)	ECG telemetry equipment (operating at 450MHz up to 15W) shall not be located closer than 6 inches (15.3cm).

*Specifications subject to change without notice.

1-6. Accessory Equipment

The following accessory equipment is available with the LIFEPAK 5.

1-7. Battery Charger. The Battery Charger is capable of delivering 300mA to each of 2 Battery/Paks. Full charge in 4-5 hours for depleted cells. The Charger contains a test load for testing the Defibrillator. The Charger will operate on 115V, 50-60Hz; 230V, 50-60Hz; or 11-15Vdc.

1-8. Battery/Pak. The Battery/Paks are made of high quality rechargeable nickel-cadmium cells with the following capabilities:

1. ECG Monitor/Recorder Unit. Capable of delivering 1.7 hours of ECG monitoring or one hour of cardioscope monitoring and 10 minutes of monitoring and recording at -10°C.

2. DC Defibrillator Unit. Capable of delivering twelve 360 joule discharges at -10°C and at least thirty-two discharges at 25°C.

1-9. Patient Cable. Ten-foot shielded three-lead cable with six pin connector (W, R, B). Use patient cable 09-10418-02 only in 3 lead Lifepak 5.

1-10. Optional Equipment. An optional ECG/Voice Recorder is available for the LIFEPAK 5 This instrument is used in conjunction with the LIFEPAK 5 ECG Monitor/Recorder. It records both the operator's voice and the patient-generated ECG signal. It is available as either a "record-only" unit or a "record-playback" unit.

An optional Battery Support System serves as a battery charger, battery capacity checker, and an available energy checker for the defibrillator. This option is available for use with the LIFEPAK 5 ECG Monitor/Defibrillator when the latter is combined with the optional ECG/Voice Recorder p/n 801595.

1-11. FEATURES AND FUNCTIONAL DESCRIPTION

The following paragraphs provide a functional description of the ECG Monitor/Recorder and DC Defibrillator units.

1-12. ECG Monitor/Recorder Unit. All controls are clearly labeled and accessible at the top of the unit. The location and function of all controls are described and illustrated in Section 2.

The patient-generated ECG waveform is displayed on either the no-fade ECG Monitor or Recorder which are driven by electrical networks designed for fast recovery from external overloading signals. The ECG Monitor trace sweeps at 25mm/sec. The Recorder provides documentation at 25mm/sec. that is delayed by 2.4 seconds. In effect, this provides the user with a 2.4 second memory. The circuitry is shielded to reject radio frequency interference.

When monitoring a patient's ECG waveform through the patient cable, the operator may select leads I, II or III. This input is completely protected from high voltage levels as may be obtained from the

1-12. ECG Monitor/Recorder Unit. (Continued)

Defibrillator. A systole beeper with adjustable volume level is provided for audible monitoring when the ECG Monitor or Recorder cannot be watched.

A momentary freeze button is provided to freeze patient ECG signals on the CRT. During FREEZE activation the recorder switches from the documentation in the normal delay mode to documentation in real time.

All information displayed on the ECG Monitor or Recorder has been stored first in a digital memory. The patient ECG signal is sampled continuously, and each time a sample has been taken, the signal at that instant is converted into a binary word and stored in the memory.

The following additional features are included in the ECG Monitor/Recorder unit: a 1V/mV ECG signal in real time is available at the ECG OUT jack for radio or telephone telemetry; a 1mV calibration switch (CAL) is provided to calibrate the instrument; a low battery indicating light that flashes when battery terminal voltage is nominally 11.5V at 25°C.

1-13. DC Defibrillator Unit. All controls are mounted on the paddles. The location of all controls are described and illustrated in Section 2.

Features on the DC Defibrillator unit include: a ready flasher indicating the state of charge of the charge storage capacitor; and a battery test function which flashes the POWER ON indicator when battery terminal voltage is nominally 11.5V at 25°C.

A charge storage capacitor is the source of the high voltage defibrillating pulse. On command, relays disconnect the capacitor from the charging circuitry and a resultant pulse is discharged through the chest of a patient through the external paddles. The energy available from the Defibrillator can be adjusted in six discrete positions ranging from 20 to 360 joules delivered. On occasion, a defibrillating pulse must be repeated. The Defibrillator generally is capable of being recharged to meet this need in 12.5 seconds.

1-14. Synchronized Cardioversion. The function of this circuit is to provide a synchronized trigger pulse to LIFEPAK 5. This trigger pulse causes delivery of the defibrillating pulse at a point nominally 30ms after the peak of the R-wave in the ECG cycle for converting atrial fibrillation, atrial flutter or other arrhythmias. By using the R-wave as the initiating signal, the defibrillating pulse is delivered at a time which avoids the vulnerable T-wave portion of the ECG cycle where electrical shock may cause ventricular fibrillation.

SECTION 2
OPERATION

2-1. GENERAL

This section provides information and procedures to properly operate and provide operator service for the LIFEPAK 5 ECG Monitor/Recorder, DC Defibrillator, Battery Charger units and Battery/Pak service.

2-2. CONTROLS AND INDICATORS

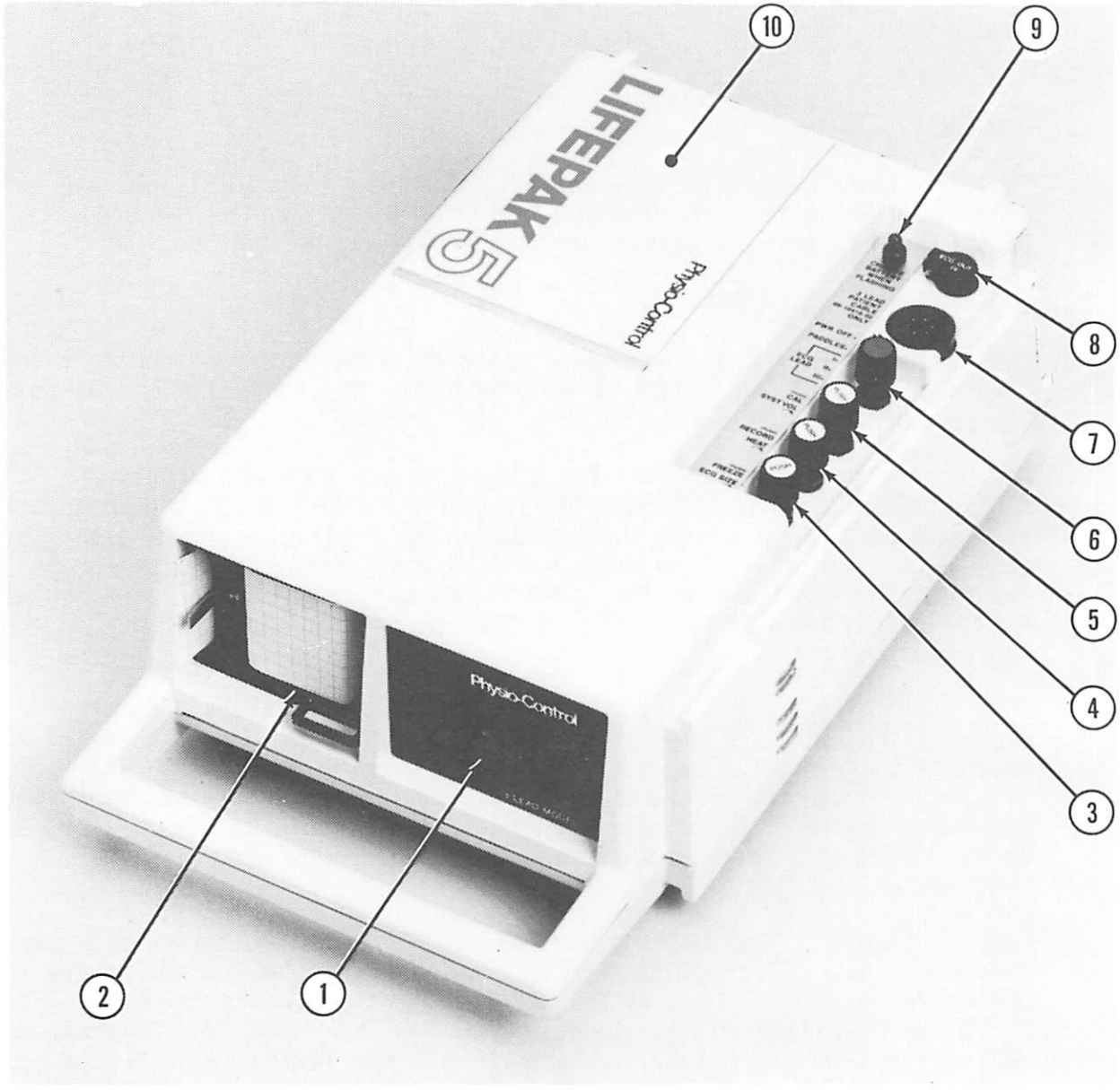
The following paragraphs provide a brief description of the controls and indicators on LIFEPAK 5 ECG Monitor/Recorder, DC Defibrillator, Battery Charger units and refers to the ECG/Voice Recorder.

2-3. ECG Monitor/Recorder Unit. The controls and indicators for the ECG Monitor/Recorder Unit are shown in Figure 2-1. Each control and indicator is keyed on the figure to the corresponding listing in Table 2-1. The table lists the control or indicator placarded nomenclature and briefly describes the function of each control or indicator. Numbers in circles in following procedural steps are the Figure 2-1 and Table 2-1 key numbers.

2-4. DC Defibrillator Unit. The controls and indicators for the DC Defibrillator unit are shown in Figure 2-2. Each control and indicator is keyed on the figure to the corresponding listing in Table 2-2. The table lists the control or indicator placarded nomenclature and briefly describes the function of each control or indicator. Numbers in circles in following procedural steps are the Figure 2-2 and Table 2-2 key numbers.

2-5. Battery Charger. The controls and indicators for the Battery Charger are shown in Figure 2-3. Each control and indicator is keyed on the figure to the corresponding listing in Table 2-3. The table lists the control or indicator placarded nomenclature and briefly describes the function of each control or indicator. Numbers in circles in following procedural steps are the Figure 2-3 and Table 2-3 key numbers.

2-6. ECG/Voice Recorder. The controls and indicators for the ECG/Voice Recorder are discussed in the LIFEPAK 5 ECG/Voice Recorder Operating and Service Manual p/n 801945.



1. ECG Monitor
2. Recorder
3. FREEZE and ECG SIZE
4. RECORD Power and Stylus HEAT
5. CAL and SYST VOL
6. Power/Mode Select
7. PATIENT CABLE Connector
8. ECG OUT
9. Low Battery Indicator
10. Battery/Pak

FIGURE 2-1. ECG MONITOR/RECORDER UNIT CONTROLS AND INDICATORS

TABLE 2-1

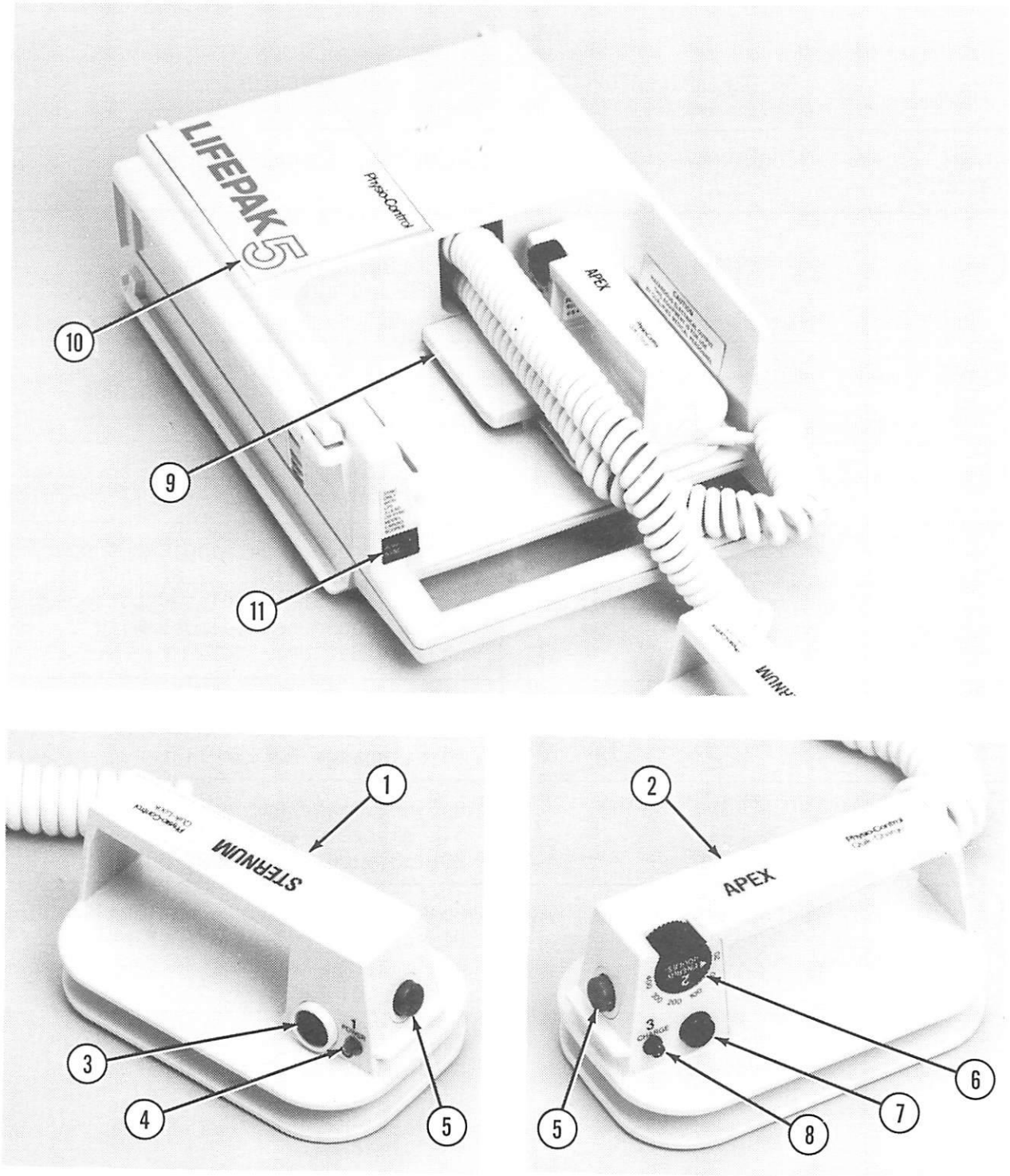
ECG MONITOR/RECORDER UNIT CONTROLS AND INDICATORS

FIGURE KEY NO.	CONTROL OR INDICATOR	FUNCTION
(1)	ECG Monitor	CRT display (no-fade).
(2)	Recorder	Heated stylus type.
(3)	FREEZE (PUSH)	Momentary PUSH to FREEZE. Recorder switches from delay mode to real time during FREEZE activation. Frozen information will read out onto recorder chart when Freeze pushbutton switch is released.
	ECG SIZE	Used to adjust simultaneously the signal amplitude fed to the ECG Monitor and Recorder. Turn clockwise to increase amplitude.
(4)	RECORD (PUSH)	Controls power to all Recorder circuits. Push to switch on, push to switch off. Main power also must be on.
	HEAT	Used to adjust temperature of writing stylus. Turn clockwise to increase temperature.
(5)	CAL (PUSH)	Momentary pushbutton which injects a positive going step corresponding to 1mV when depressed. Convenient for presetting ECG SIZE in absence of input ECG. To standardize Recorder, adjust the ECG SIZE until a 10mm square wave is obtained.
	SYST VOL	Used to adjust sound volume of systole beeper.
(6)	Power/Mode Select	Power off in fully clockwise position. Counterclockwise rotation turns power on and selects any one of four monitoring modes: Paddles, Lead I, Lead II or Lead III.

TABLE 2-1 (Continued)

ECG MONITOR/RECORDER UNIT CONTROLS AND INDICATORS

FIGURE KEY NO.	CONTROL OR INDICATOR	FUNCTION
⑦	Patient Cable Connector	6 pin patient cable connector. Use patient cable 09-10418-02 only in 3 lead Lifepak 5.
⑧	ECG OUT	1V/mV ECG output jack for radio or telephone (optional 1mV/mV).
⑨	Low Battery Indicator	Flashing (red) indicates depleted battery.
⑩	Battery/Pak	Provides power to unit. Can be removed for charging.



1. STERNUM Paddle
2. APEX Paddle
3. POWER Pushbutton
4. POWER Indicator
5. Discharge Pushbutton
6. ENERGY JOULES
7. CHARGE Pushbutton
8. CHARGE Indicator
9. Interlock Switch
10. Battery/Pak
11. Synchronizer Pushbutton

FIGURE 2-2. DC DEFIBRILLATOR UNIT CONTROLS AND INDICATORS

TABLE 2-2

DC DEFIBRILLATOR UNIT CONTROLS AND INDICATORS

FIGURE KEY NO.	CONTROL OR INDICATOR	FUNCTION
(1)	STERNUM Paddle	Contains a POWER Pushbutton, a POWER Indicator and a Discharge Pushbutton.
(2)	APEX Paddle	Contains a Discharge Pushbutton, ENERGY JOULES selector, CHARGE pushbutton and CHARGE Indicator.
(3)	POWER* Pushbutton 1	Press to switch on, press to switch off. Controls power to all circuits.
(4)	POWER Indicator (Low Battery Level Indicator)	Steady green light indicates power on to Defibrillator. Green flashing light indicates depleted battery, which should be replaced with charged Battery/Pak.
(5)	Discharge Pushbutton	Discharge Pushbutton on both paddles must be depressed simultaneously to discharge Defibrillator.
(6)	ENERGY* JOULES 2	Defibrillator energy selector. Six discrete energy levels available: 20, 50, 100, 200, 300, 360 joules.
(7)	CHARGE* Pushbutton 3	Pushbutton to charge Defibrillator. Depress and release. Defibrillator will charge to level set on ENERGY JOULES selector.
(8)	CHARGE Indicator	Light flashes amber during charge cycle, steady amber when ready, flashes again when unit has bled down to approximately 90% of selected energy level.

*NOTE: ON THE PADDLES, THE NUMERALS ON THE CONTROLS EMPHASIZE THE SEQUENCE OF OPERATION.

TABLE 2-2 (Continued)

DC DEFIBRILLATOR UNIT CONTROLS AND INDICATORS

FIGURE KEY NO.	CONTROL OR INDICATOR	FUNCTION
(9)	Interlock Switch	Switch prevents unit from being on while paddles are stored. Defibrillator cannot be turned on while paddles are stored. If paddles are removed while power is on, power will be turned off and any charge dumped when paddles are stored.
(10)	Battery/Pak	Provides power to unit. Can be removed for charging.
(11)	SYNC (PUSH) Pushbutton and Indicator	Pushbutton switch for selecting either the synchronize defibrillate or the manually triggered defibrillate mode (pushbutton illuminates when SYNC mode selected).

TABLE 2-3

BATTERY CHARGER CONTROLS AND INDICATORS

FIGURE KEY NO.	CONTROL OR INDICATOR	FUNCTION
(1)	CHARGING Indicator	Red indicator is on when charging is in progress.
(2)	TEST LOAD Indicator	Amber indicator will light when the defibrillator delivers over 160 joules and will not light if the delivered energy is under 80 joules.
(3)	Test Load Pads	Provides access for paddles to internal 50Ω load.
(4)	TIME Indicator	Green indicator illuminates after Battery/Pak has been charged for 4.5 hours.

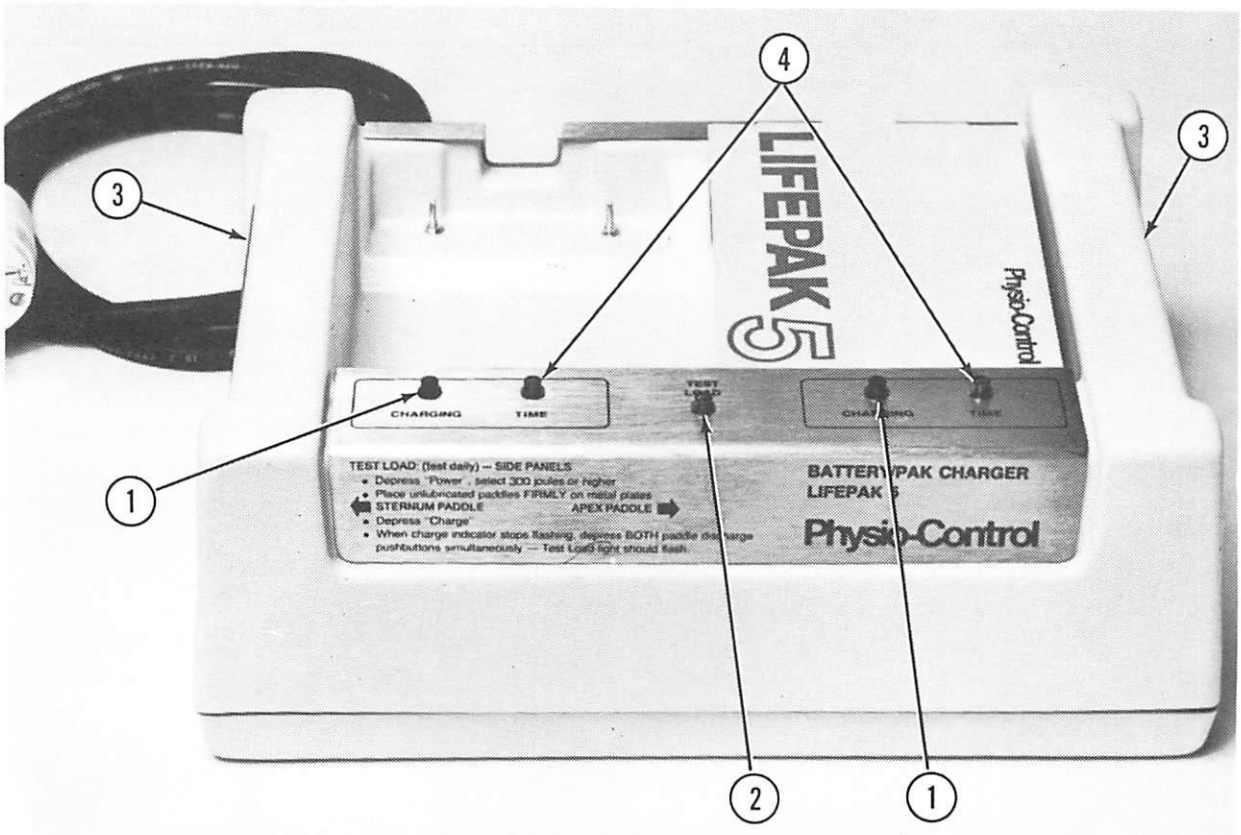


FIGURE 2-3. BATTERY CHARGER CONTROLS AND INDICATORS

2-7. OPERATING INSTRUCTIONS

Operating instructions are presented for the LIFEPAK 5 ECG Monitor/Recorder, DC Defibrillator and Battery Charger units. Observe the following cautions while operating the LIFEPAK 5.

WARNING

- This instrument is to be used by authorized personnel only.
- Operator should be thoroughly familiar with information covered in Sections 1 and 2 before using.
- The LIFEPAK 5 should not be used in the presence of flammable agents or anesthetics.
- Do not discharge Defibrillator with paddles shorted together.
- Stay clear of patient when defibrillating.
- For patient and operator safety, do not connect accessory equipment to the ECG OUT jack unless accessory equipment in combination with LIFEPAK 5 has been evaluated for fire and shock hazard.

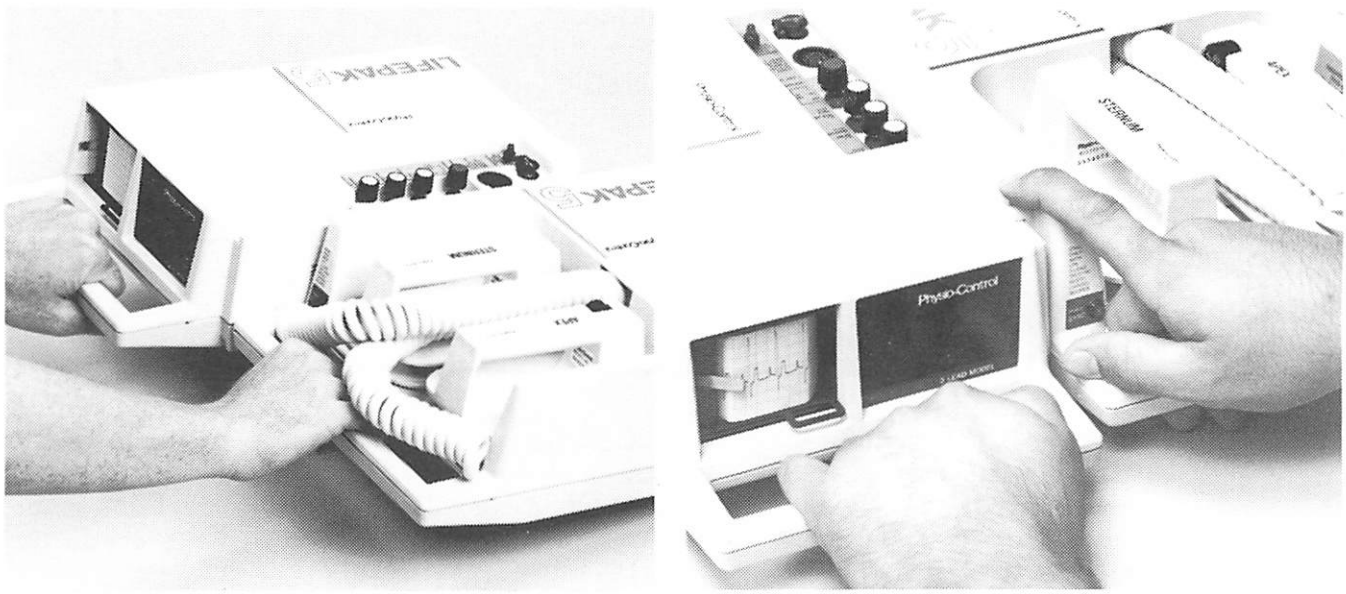
2-8. Electrode Application. The LIFEPAK 5 uses a special six-pin patient cable connector (see Fig. 2-1, (7)), and three-lead cable. The use of this cable has resulted in a reduction in cable related artifact. Part of the improvement from the past comes from running the cable shielding all the way down to the cable snaps. This cable, therefore, has heavier leads which do not easily tangle and are not replaceable. A similar cable with 5 leads may be used; however, the "right leg" and "V" lead" are not used.

Proper electrode site selection and preparation is a major consideration in the reduction of muscle artifact and skin resistance. The best results may be obtained by (a) selecting a site where skin folding is minimal (b) avoiding areas over large skeletal muscles. Skin resistance may be reduced by (a) thoroughly cleaning the skin by firmly rubbing it with a wet cloth (a skin cleaning agent may be used if it can be completely rinsed afterwards), (b) shaving the electrode site if hair is present. Motion artifact can be minimized by preventing the cable from pulling against the electrode. Taping a small loop in the cable against the skin near the electrode will help to relieve the strain on the electrode.

Non-prejelled electrodes should be connected to the cable snaps, have 1/4 inch to 1/2 inch (6.4mm to 12.7mm) of jel applied in a mound over the screen, then attached to the patient. Prejelled electrodes should be attached to the cable snaps, inspected to insure that the jel has not dried out, then attached to the patient.

2-9. Unit Connection. The ECG Monitor/Recorder unit is connected to the DC Defibrillator unit through a special slide connector, as shown in Figure 2-4. The slide connector makes both mechanical and electrical connection between the two units. The top two electrical contacts are used to transfer low level ECG signals from the Defibrillator paddle plates to the Monitor Preamplifier input. The bottom three contacts are used to transfer sync information between the Monitor and Defibrillator when the instrument is being used in the synchronized mode. Battery power is not transfered by this contact.

The units are separated by pressing the lock release button on the left side of the Defibrillator. When the units are separated, the electrical slide contacts are exposed. These exposed contacts do not represent a safety hazard and no dangerous voltages are ever present at these contacts.



Slide Connection Lock Release

FIGURE 2-4. UNIT CONNECTION

2-10. ECG Monitor/Recorder Unit. The following paragraphs provide brief operating instructions for the LIFEPAK 5 ECG Monitor/Recorder unit. Refer to paragraph 2-14 for Operator Service which includes an operational checkout. Numbers in circles refer to Figure 2-1 and Table 2-1.

1. Plug patient cable into PATIENT CABLE (7) connector. If paddles are to be used, the ECG Monitor/Recorder and DC Defibrillator units must be joined together.

2. Attach either patient cable or paddles to patient.

3. Set Power/Mode Select switch (6) to position desired (Paddles, I, II or III).

2-10. ECG Monitor/Recorder Unit. (Continued)

CAUTION

Do not drain the battery completely; turn the instrument Pwr/Mode select switch (6) off when not in use.

4. If Recorder monitoring is desired, depress RECORD (4) pushbutton. Adjust stylus HEAT (4) control as required.

NOTE: If paper replacement is required refer to paragraph 2-18.

5. Depress CAL (5) momentary pushbutton, adjust ECG SIZE (3) control for a 10mm square wave display on Recorder (2) or a convenient display on ECG Monitor (1) .

6. Adjust ECG SIZE 3 control to obtain desired patient generated ECG display on ECG Monitor (1) and/or Recorder (2) .

7. Adjust SYST VOL (5) to desired volume.

8. An ECG modulator or other external monitoring devices may be connected to the ECG OUT (8) jack.

9. Depress FREEZE (3) to freeze signal on the CRT, if desired.

WARNING

For patient safety do not connect accessory equipment to the ECG OUT (8) unless the accessory equipment in combination with the LIFEPAK 5 has been evaluated for fire and shock hazard.

2-11. DC Defibrillator Unit. The following paragraphs provide brief operating instructions for LIFEPAK 5 DC Defibrillator Unit. Monitoring using the paddles is discussed in paragraph 2-10. Refer to paragraph 2-14 for Operator Service including an operational checkout. Numbers in circles refer to Figure 2-2 and Table 2-2. ON THE PADDLES, THE NUMERALS ON THE CONTROLS EMPHASIZE THE SEQUENCE OF OPERATION.

1. Depress and release POWER (3) pushbutton on STERNUM (1) paddle. Green POWER indicator (4) will light.

2. Set ENERGY JOULES (6) to desired level.

3. Depress CHARGE (7) pushbutton and release.

4. Place paddles firmly on patient's chest.

2-11. DC Defibrillator Unit. (Continued)

5. Defibrillator is ready to fire when amber CHARGE Indicator (8) light stops flashing and glows steady amber. Defibrillator will not fire unless fully charged to preset level.

NOTE: Once the Defibrillator has charged to the desired level and the CHARGE Indicator (8) stops flashing, the unit is ready to fire. If not fired, the charge will slowly bleed down. Once the charge has bled to 90% of the desired level, the CHARGE Indicator (8) will flash two or three times and the Defibrillator will automatically recharge to the desired level.

If the ENERGY JOULES (6) selector position is changed while the Defibrillator is charged, the charge is automatically dumped. It is necessary to recharge the unit to defibrillate at a different setting.

WARNING

Stay clear of patient when defibrillating.

6. Depress both paddle discharge pushbuttons (5) simultaneously for counter shock.

7. If repeat counter shock is indicated, depress CHARGE (7) and repeat as above.

8. To dump charge and turn off Defibrillator, depress POWER (3) pushbutton on STERNUM (1) paddle. POWER light (4) will go out.

2-12. Synchronized Cardioversion. The following paragraphs provide brief operating instructions for the LIFEPAK 5 synchronized cardioversion.

NOTE: Synchronized cardioversion is not possible unless ECG Monitor/Recorder and Defibrillator units are connected.

1. Connect the ECG Monitor/Recorder and Defibrillator units together.

2. Connect patient to Patient Cable and set Power/Mode Select switch to Lead I, II or III, Figure 2-1 (6).

3. Push POWER button on STERNUM paddle. Defibrillator will come on in manually triggered defibrillate mode.

2-12. Synchronized Cardioversion. (Continued)

> **WARNING**
>
> DO NOT use Defibrillator paddles as ECG pickup for elective cardioversions. Artifact from poor contact or movement of paddles could cause synchronizer to fire Defibrillator prematurely.

4. Push SYNC pushbutton switch ON, Figure 2-2 (11). Red switch button will illuminate.

5. Adjust ECG SIZE control, Figure 2-1 (3), until sync marker occurs on ECG complex on ECG Monitor (CRT). SYNC pushbutton switch will flash and SYSTOLE SOUND will beep with marker (it may be necessary to move the electrodes to get a signal with sufficient amplitude).

6. Set ENERGY JOULES, Figure 2-2 (6) to desired level.

7. Depress CHARGE pushbutton, Figure 2-2 (7), and release.

8. To discharge, depress BOTH discharge buttons and hold until Defibrillator fires on the next R-wave. Defibrillator will fire within 20ms of marker.

   After discharge, the Defibrillator automatically returns to the emergency defibrillate mode. If repeat synchronized cardioversion is required, place the Defibrillator in the SYNC mode again by depressing the SYNC pushbutton switch ON, Figure 2-2 (11). When button is illuminated, synchronizer is on.

2-13. Battery Charger. The following procedures provide brief operating instructions for LIFEPAK 5 Battery Charger. A discharged Battery/Pak requires 4-5 hours in the charger to insure a complete recharge. Each Battery/Pak recharges independently in the charger so either one or two Battery/Paks may be inserted. Proceed as follows:

1. Connect the Battery Charger to a source of power (115 VAC, 230VAC or 12Vdc). A power cord is provided for AC input, a jack for dc input.

   NOTE: This dc input jack accepts a standard RCA-type phone plug (switchcraft No. 3502). The center conductor must be connected to +12Vdc and the shield to ground. This dc input source must be fused externally (2.0 amps).

2. Align the Battery/Pak with the recessed mounting area so that the Battery/Pak clip is towards the rear.

3. Lower the front end of the Battery/Pak into the recessed mounting area.

4. Lower the rear end of the Battery/Pak into the recessed mounting area.

2-13. Battery Charger. (Continued)

5. Verify that the CHARGING indicator, Figure 2-3 1 , illuminates (a 3-second delay in illumination of the CHARGE indicator is normal).

6. After 4-5 hours of charging, the TIME indicator should illuminate which indicates that the Battery/Pak has been charged to its maximum capacity (maximum Battery/Pak capacity will vary depending upon the ambient temperature at which it is charged, see step 7).

7. A Battery/Pak may be left in the charger indefinitely without damaging it; however, longest life will be obtained when it is exercised regularly per paragraph 2-17.

NOTE: To maximize battery life and capacity, the Battery/Pak should be charged at a room ambient temperature (approximately 22°C, 70°F).

2-14. **OPERATOR SERVICE**

The following paragraphs provide operator service procedures, including daily operational checkout, Battery/Pak replacement, recorder paper replacement and recorder stylus adjustment and replacement.

2-15. Operational Checkout. Table 2-4 provides an operational checkout procedure for the ECG Monitor/Recorder and Table 2-5 provides an operational checkout procedure for the Defibrillator unit. These procedures may be performed simultaneously if both units are joined together.

These procedures will determine whether or not the LIFEPAK 5 ECG Monitor/Recorder and DC Defibrillator units function normally. The tests should be performed as routine maintenance on a daily basis. The operational checkout procedures are presented in tabular form to allow the using activity to copy them and use them as an ongoing preventive maintenance aid.

Operational Checkout of the ECG/Voice Recorder is described in the ECG/Voice Recorder manual p/n 801945.

2-16. Battery/Pak Replacement. Refer to Figure 2-5 and proceed as follows:

1. To remove the Battery/Pak, press button at rear of Battery/Pak and lift.

2. To install the Battery/Pak proceed as follows:

   a. Align the Battery/Pak with the recessed area so that the Battery/Pak clip is towards the rear.

   b. Lower the front end of the Battery/Pak into the recessed area.

   c. Lower the rear end of the Battery/Pak into the recessed area and press until a click is heard.

TABLE 2-4

ECG MONITOR/RECORDER UNIT OPERATIONAL CHECKOUT

PROCEDURE	RESULTS
NOTE: This procedure may be performed in conjunction with the DC Defibrillator Unit Checkout presented in Table 2-5 All numbers in circles are key numbers in Figure 2-1.	
1. Install Battery/Pak (refer to paragraph 2-17), if necessary.	
2. Attach Patient Cable to patient cable Connector (7).	
3. Set Power/Mode Select switch (6) to Lead I, II or III.	Verify that a luminous trace appears on the ECG Monitor.
4. Observe the Low Battery Indicator (9) .	Verify that Low Battery Indicator does not flash on and off. If it does, refer to paragraph 2-13.
5. Depress RECORD (4) pushbutton.	Verify that recorder starts. If paper replacement is required, refer to paragraph 2-18.
6. Adjust stylus HEAT (4) control for a satisfactory trace on recorder.	Verify that satisfactory line width and darkness is obtained on the recorder.
7. Depress CAL (5) momentary pushbutton and adjust ECG SIZE (3) control to obtain 10mm display on recorder.	Verify that a satisfactory display (pulse) is obtained on the recorder. If not, refer to maintenance procedures.
8. Observe display on CRT.	Verify that a satisfactory display pulse is obtained on the CRT. If not, refer to maintenance procedures.
9. Touch patient cable leads while increasing the setting of the SYST VOL (5) control.	Systole beeper should sound.
10. Observe CRT display while touching patient cable contacts.	Verify that the CRT exhibits erratic vertical deflections.
11. Depress FREEZE (3) button.	Verify trace is frozen on CRT.
12. Depress RECORD (4) push-button.	Verify frozen trace is read on recorder when FREEZE switch is released.

TABLE 2-5

DC DEFIBRILLATOR UNIT OPERATIONAL CHECKOUT

PROCEDURE	RESULTS
NOTE: This procedure may be performed in conjunction with the ECG Monitor/Recorder Unit Checkout presented in Table 2-4. All numbers in circles are key numbers in the figure number indicated. The Battery Charger will be required in this test.	
1. Install Battery/Pak (refer to paragraph 2-17), if necessary.	
2. If ECG Monitor/Recorder is connected to the Defibrillator unit, test ECG Monitor/ Recorder according to Table 2-4. Proceed with the following steps after completing steps in Table 2-4. If the ECG Monitor/ Recorder is not connected, proceed to step 10.	
3. Verify Defibrillator POWER Indicator, Figure 2-2 (4), is off.	
4. Set Power/Mode Select switch on ECG Monitor/Recorder, Figure 2-1 (6), to PADDLES position.	Verify that a luminous trace appears on the CRT.
5. Touch one paddle face. ECG SIZE, Figure 2-1 (3), may require adjustment.	Interference should appear on the CRT.
6. Increase setting of ECG Monitor/ Recorder SYST VOL, Figure 2-1 (5), while touching paddle.	Systole beeper should sound.
7. Repeat steps 5 and 6 for other paddle.	See steps 5 and 6.
8. Depress RECORD pushbutton, Figure 2-1 (4), on ECG Monitor/ Recorder unit. Repeat interference test by touching paddles. Recorder stylus HEAT, Figure 2-1 4, may require adjustment. After test, depress RECORD (4) pushbutton to turn recorder off.	Interference should appear on the recorder.
9. Depress Defibrillator POWER Pushbutton, Figure 2-2 (3).	Verify green POWER Indicator, Figure 2-2 (4), lights.

TABLE 2-5 (Continued)

DC DEFIBRILLATOR UNIT OPERATIONAL CHECKOUT

PROCEDURE	RESULTS
10. Set ENERGY JOULES selector, Figure 2-2 (6), to 200 joules	
11. Place paddles firmly on Battery Charger Test Load Pads, Figure 2-3 (3).	

CAUTION

Do not lubricate paddles. Do not discharge paddles in open air. Use firm contact at time of discharge on test load plates to prevent arcing, pitting of paddles, and to insure delivery of energy. Because of heat created at time of discharge into test load, do not repeat testing of Defibrillator more often than 10 timer per hour.

12. Depress CHARGE Pushbutton, Figure 2-2 (7).	Charge Indicator, Figure 2-2 (8), should flash until selected energy level is reached,then glow steady amber.
13. Depress both paddle Discharge Pushbuttons, Figure 2-2 (5).	Battery Charger TEST LOAD Indicator, Figure 2-3 (2), should flash.
14. Set ENERGY JOULES, Figure 2-2 (6), to 50joules.	
15. Place paddles firmly on Battery Charger test load pads, Figure 2-3 (3).	
16. Depress CHARGE pushbutton, Figure 2-2 (7).	
17. Depress both paddle Discharge Pushbuttons, Figure 2-2 (5).	Verify that Battery Charger TEST LOAD Indicator, Figure 2-3 (2), does not flash.
18. Set power/mode select to PWR OFF, Figure 2-1 (6) and depress the Defibrillator POWER, Figure 2-2 (3) pushbutton.	Verify all power is removed from ECG Monitor/Recorder and Defibrillator units.

TABLE 2-5 (Continued)

DC DEFIBRILLATOR UNIT OPERATIONAL CHECKOUT

PROCEDURE	RESULTS
19. Insert paddles fully in their compartments. Depress the POWER pushbutton, Figure 2-2 (3).	POWER Indicator, Figure 2-2 (4), will not light.
20. Remove left paddle from compartment. Depress POWER Pushbutton, Figure 2-2 (3).	POWER Indicator, Figure 2-2 (4), will light.
21. Insert paddle back into compartment.	POWER Indicator, Figure 2-2 (4), will extinguish.

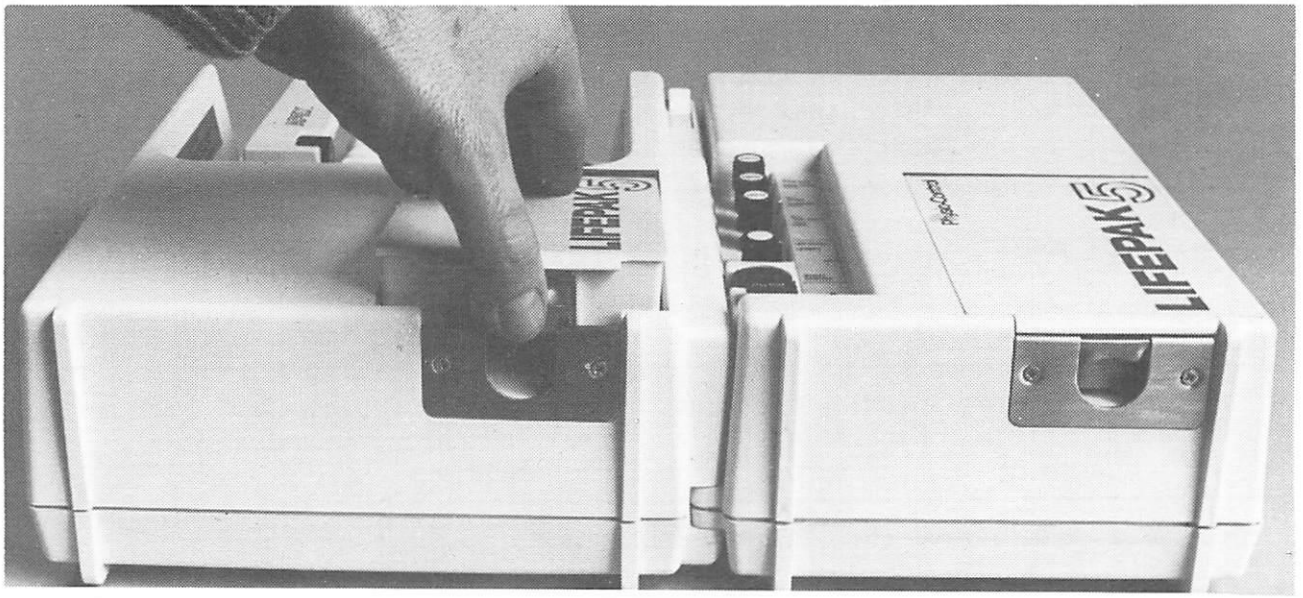


FIGURE 2-5. BATTERY/PAK REPLACEMENT

2-16. Battery/Pak Replacement. (Continued)

3. Longest life will be obtained from the Battery/Paks when they are exercised every 3 or 4 months as follows:

   a. Install Battery/Pak in Defibrillator.

   b. Set ENERGY JOULES selector to maximum energy level.

   c. Turn Defibrillator on.

   d. With the paddles firmly placed on Battery Charger test load pads, charge and discharge Defibrillator paddles until charge up time exceeds 30 seconds (see Table 2-5, item 13).

2-17. Recorder Paper Replacement. Refer to Figure 2-1 and 2-6 then proceed as follows:

1. Pull out paper carrier.
2. Remove old paper roll.
3. Replace with new paper roll.
5. Turn on main power, Figure 2-1 (6).
6. Depress Record Power pushbutton, Figure 2-1 (4). While Recorder is running, guide paper over all metal rollers and under rubber roller. Paper will be pulled through by rubber roller.
7. Verify that the Stylus HEAT control, Figure 2-1 (4), provides adjustment for a satisfactory line width and darkness. If not, refer to paragraph 4-55.

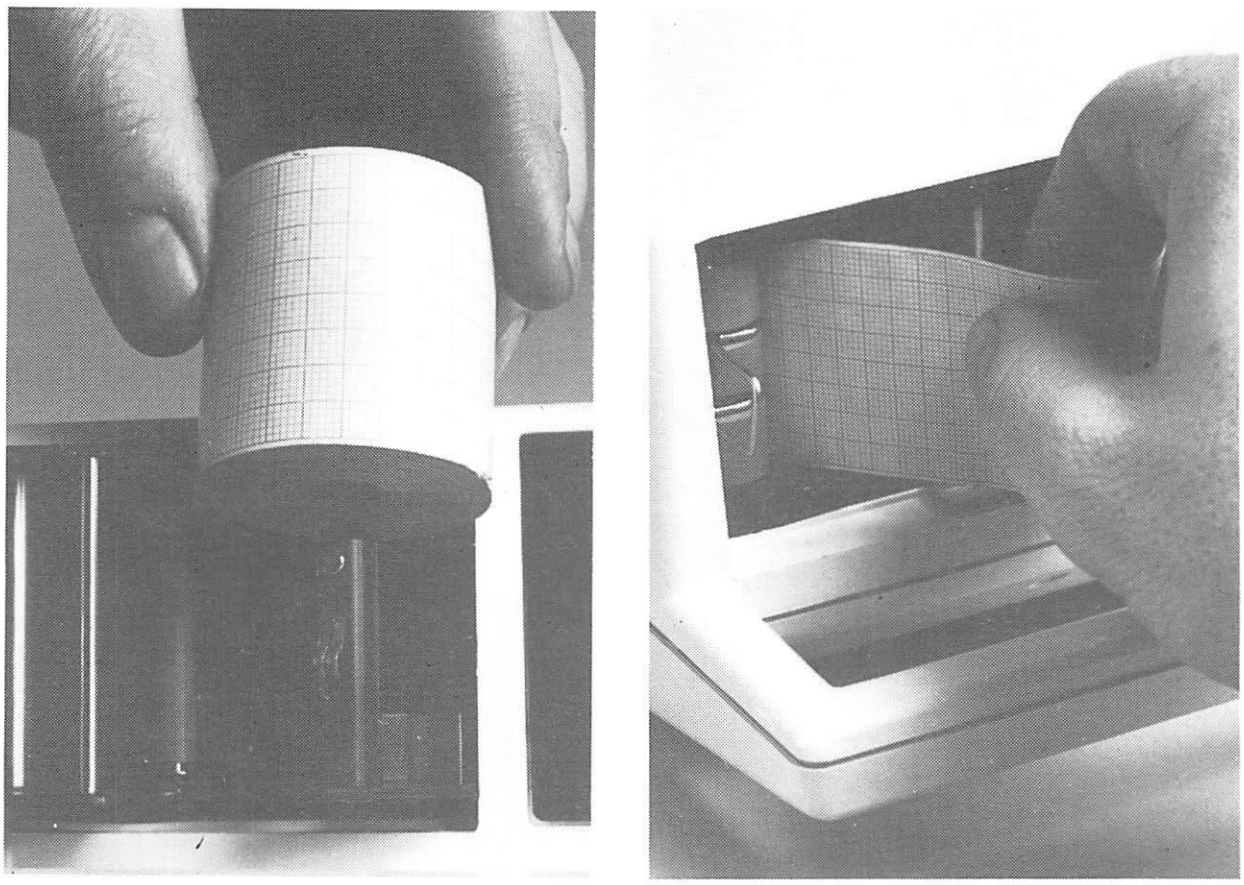


FIGURE 2-6. RECORDER PAPER REPLACEMENT

2-18. Recorder Stylus Replacement and Adjustment.

If stylus replacement or adjustment is necessary, contact a Physio-Control Field Service Representative for current replacement instruction.

SECTION 3
CIRCUIT DESCRIPTION

3-1. INTRODUCTION

This section provides a detailed description of the circuits contained in LIFEPAK 5 ECG Monitor/Recorder and DC Defibrillator units. The section is organized into four major parts. A brief functional or block diagram description of the overall operation of the LIFEPAK 5 is presented first. The subsequent parts are presented by ECG Monitor/Recorder Unit, DC Defibrillator Unit and Accessory Equipment.

3-2. Functional Description. The LIFEPAK 5 Block Diagram presented in Figure 3-1 provides an overall view with typical waveforms and direction of travel. Schematic diagrams of the major circuits are also provided to allow for examination of the circuits from two levels while reading the circuit descriptions.

NOTE: The schematics provided in this section may differ slightly from the configuration of the equipment supplied. The current information will be found in the Change Information Section at the back of the manual.

In the Monitor, the patient ECG signal is routed through either the patient cable or paddles to the input and amplifier stage. In the input and amplifier stage the ECG signal is filtered, amplified, modulated, demodulated and further amplified before it is sent to the no-fade circuitry.

In the no-fade circuitry, the ECG signal is converted from analog to digital form. The digital information is stored in a memory and reconverted to analog form for display on the ECG Monitor and Recorder.

To accomodate the optional ECG/Voice Recorder arrangements are made in the ECG Monitor to turn on the cassette recorder automatically when the monitor unit is switched on. The monitor can supply a standardization signal (1mV/1V) to the recorder, while at the same time, it displays the patient's ECG on the CRT. The real-time patient cable ECG signal is inhibited during playback, while the patient's recorded ECG signal is displayed on the monitor CRT.

In the Defibrillator, the energy of the defibrillator pulse is stored as a charge on a capacitor located in the defibrillator unit. On command, relays disconnect the capacitor from the charging circuitry and connect it to the paddles which deliver the resulting electrical pulse to the patient.

3-3. ECG MONITOR/RECORDER UNIT

The LIFEPAK 5 ECG Monitor/Recorder Unit circuit description is presented by individual circuit function starting with the Input and Amplifier Circuitry and continuing through the No-Fade, ECG Monitor and Recorder Display, Systole Sound, Power Supply and Low Battery Level

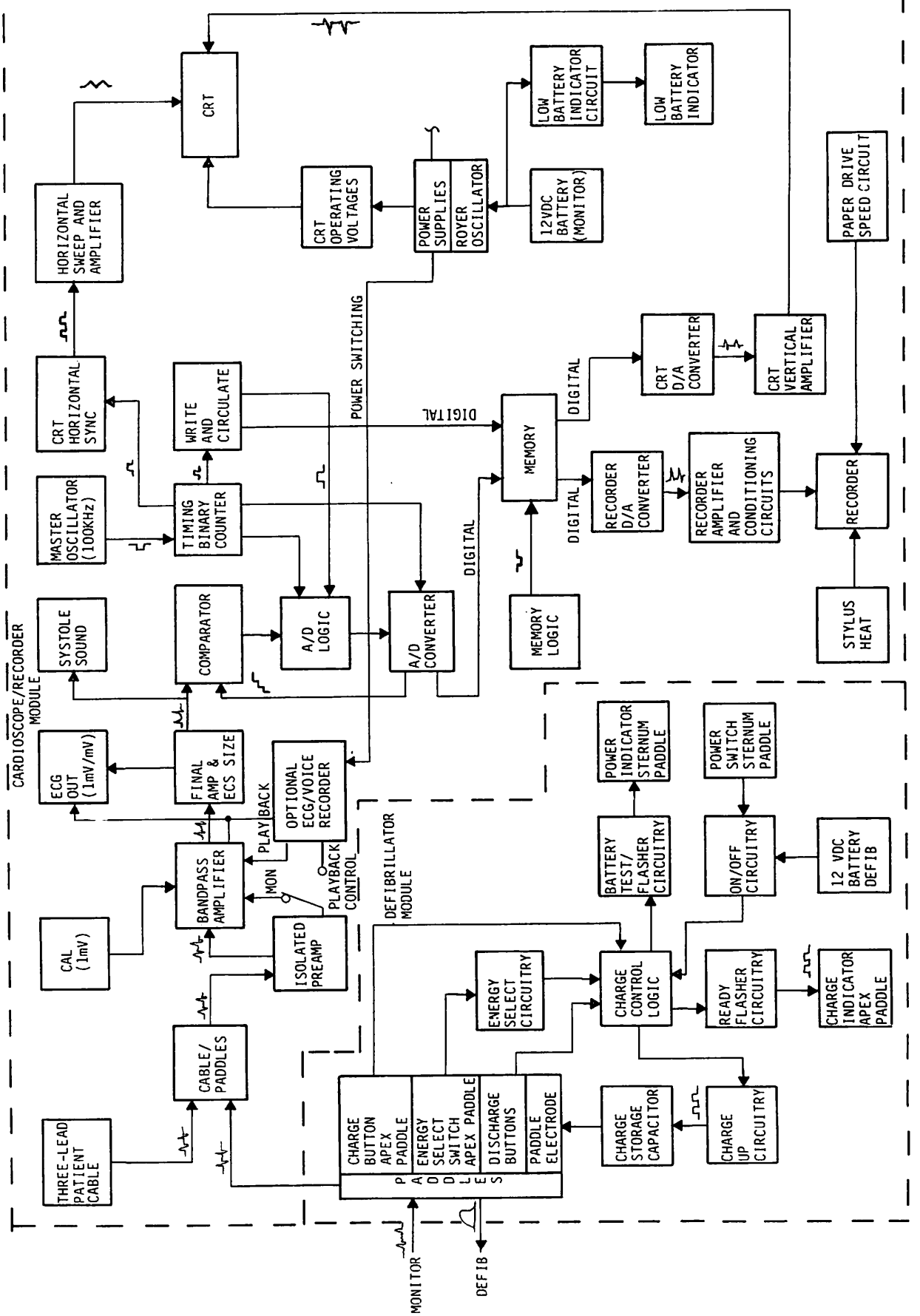


FIGURE 3-1. LIFEPAK 5 BLOCK DIAGRAM

3-3. ECG MONITOR/RECORDER UNIT (Continued)

Circuitry. The ECG Monitor Recorder Wiring Diagram in Section 5 provides the complete interconnection data for the subassemblies comprising the ECG Monitor/Recorder unit.

3-4. Input and Amplifier Circuitry. The following paragraphs describe the Input and Amplifier Circuitry including Patient Cable and Paddles followed by detailed circuit analysis. Figure 3-2 provides an expanded block diagram of the input and amplifier stages showing interface with other circuitry. The input and amplifier stages are physically located on the Preamp PCB. The paddles are physically located with the DC Defibrillator unit. For a more detailed analysis, Figure 3-3 provides an Input and Amplifier Circuitry -Schematic Diagram.

3-5. Patient Cable and Paddles. The patient generated ECG signal is fed into the ECG Monitor/Recorder through either the patient cable or paddles. The paddles, part of the DC Defibrillator unit, permit quick assessment of the patient's condition during an emergency. Refer to paragraph 3-35 for detailed information concerning the DC Defibrillator Unit. The standard three-lead patient cable and electrodes are used for long term monitoring and during patient transportation.

Preamplifier protection against overvoltage, inadvertently introduced through the patient cable, is provided by voltage surge protectors VSP1 through VSP4. These voltage surge protectors are mounted on the control PCB. VSP1, VSP2, and VSP4 shunt inadvertent voltages above 90V to the isolated preamp ground. Voltages above 470V on the isolated ground are shunted to the chassis ground by surge protector VSP3. Additional voltage surge protection is provided in the DC Defibrillator unit when the paddles are used.

A five-position Power/Mode Select switch S1, mounted on the control board, switches power and selects patient cable Leads I, II, III or paddles. The ECG signal from the paddles is fed through a transfer relay to switch S1. The transfer relay disconnects the charge storage capacitor from the paddles. The patient cable connector is wired directly to switch S1 through surge protectors VSP1 through VSP4. From S1, the ECG signal is routed to the preamplifier overvoltage protection circuitry. In either case, the third lead is used as a reference.

3-6. Isolated Preamplifier Circuitry. Input RF1 filtering is provided at the input to U5 by C30 through C32. Input common mode or normal mode voltages greater than plus or minus 10V are clamped to the isolated power supply through diodes CR6 through CR9. These over-range voltages are dropped across resistors R36 and R37.

Isolated power is produced for the isolated preamplifier from a fullwave bridge rectifier consisting of T2, CR13, through CR16, C37, and C38. The primary of T2 receives 48V peak-to-peak (p-p), 12KHz from the Royer oscillator through J3-1 and J3-2. Refer to the Isolated Power Supply description presented in paragraph 3-29 for additional details.

3-6. Isolated Preamplifier Circuitry. (Continued)

Voltage gain in the symmetrical differential first stage of amplification (U5) is nominally 50. Its output is proportional to the differential voltage at the input. This stage also acts as a low pass filter for RF frequencies which is determined by C30, C31, and C32. Rapid recovery from large dc offsets at the output of U5 is accomplished by the dc stabilization circuit consisting of U6, R47, CR10 and CR11.

Large dc offsets occur when power is first applied at instrument turn-on or when the paddles or patient cable electrodes are moved on the patient and drive the CRT trace off the display screen. Fast circuit recovery is necessary to minimize the trace off-screen time. Under normal conditions, the input of U6 is connected to the U5 output by R46. R46 and C33 provide a low frequency roll-off at approximately 0.04Hz. Any dc signal from U5 at R46 generates a compensating signal which is fed back to U5 through DS1. C36 slows down the fast recovery response to allow the display of pacemaker signals.

3-7. Chopper Isolator Circuitry. To preserve isolation of the circuitry, the amplified ECG signal is transformer coupled to the other ECG Monitor/Recorder circuitry. To preserve the very low frequency components of the ECG wave, which would be lost in conventional inductive coupling of a transformer, the signal is chopped at a rapid rate, passed through a transformer, then sampled at the same rate and filtered to remove the chopper frequency component.

FET chopper Q6 is driven by the 12KHz square wave from the non-inverting secondary of T2, which is also the source for the isolated power supply. The chopping action of Q6 effectively amplitude modulates the 12HKz signal with the ECG signal. The ground return of the primary of T1 and the center tap of T2 is isolated ground.

FET chopper Q7 is driven by the 12KHz square wave from the primary of T2. Thus, the frequency and phase of the voltages driving Q6 and Q7 are the same. This action essentially demodulates the 12KHz modulated signal and restores the ECG signal. U4 determines the low end roll-off of the restored ECG signal. U4 is instrumental in eliminating unwanted low frequency signals such as drift within the circuitry or electrode offset potential produced between the input electrodes.

3-8. CAL (1mV) Circuitry. The CAL circuitry injects a step voltage corresponding to 1mV referenced to patient input when the CAL switch S4 is depressed. The switch is physically located on the control board.

The overall gain of the isolated preamp and chopper isolator stages is approximately 50. Therefore, the calibration signal injected at the input to U1 must be 50 times the 1mV calibration signal at the preamplifier input that it simulates.

When the CAL switch is depressed, the output of a five volt divider is applied to the input of U1. The divider is made up of R1, R2 and R3. Pot R2 is adjusted to produce a voltage step of 1V at the ECG OUT jack or 1mV if the optional 1mV/mV output is installed.

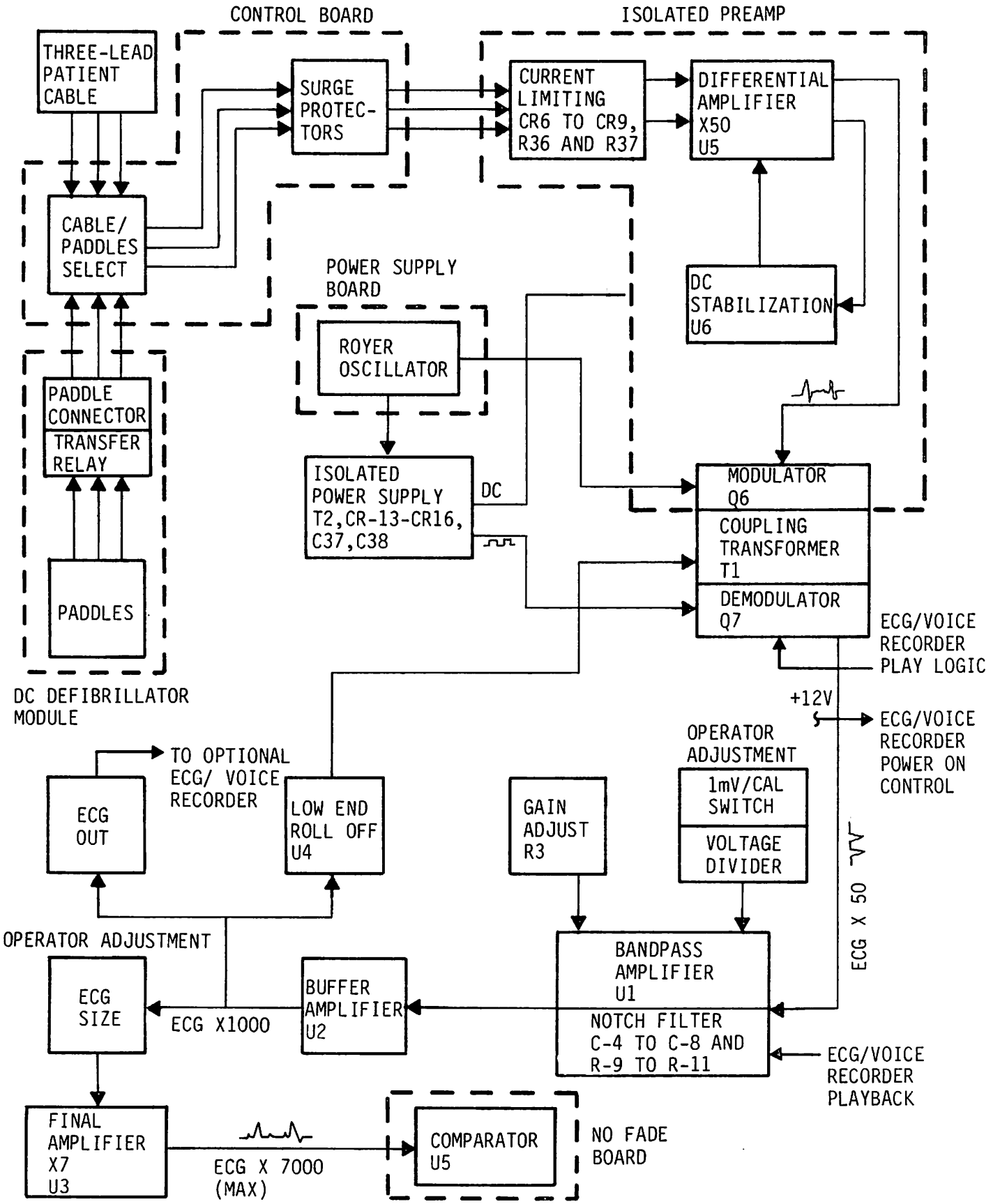


FIGURE 3-2. INPUT AND AMPLIFIER - EXPANDED BLOCK DIAGRAM

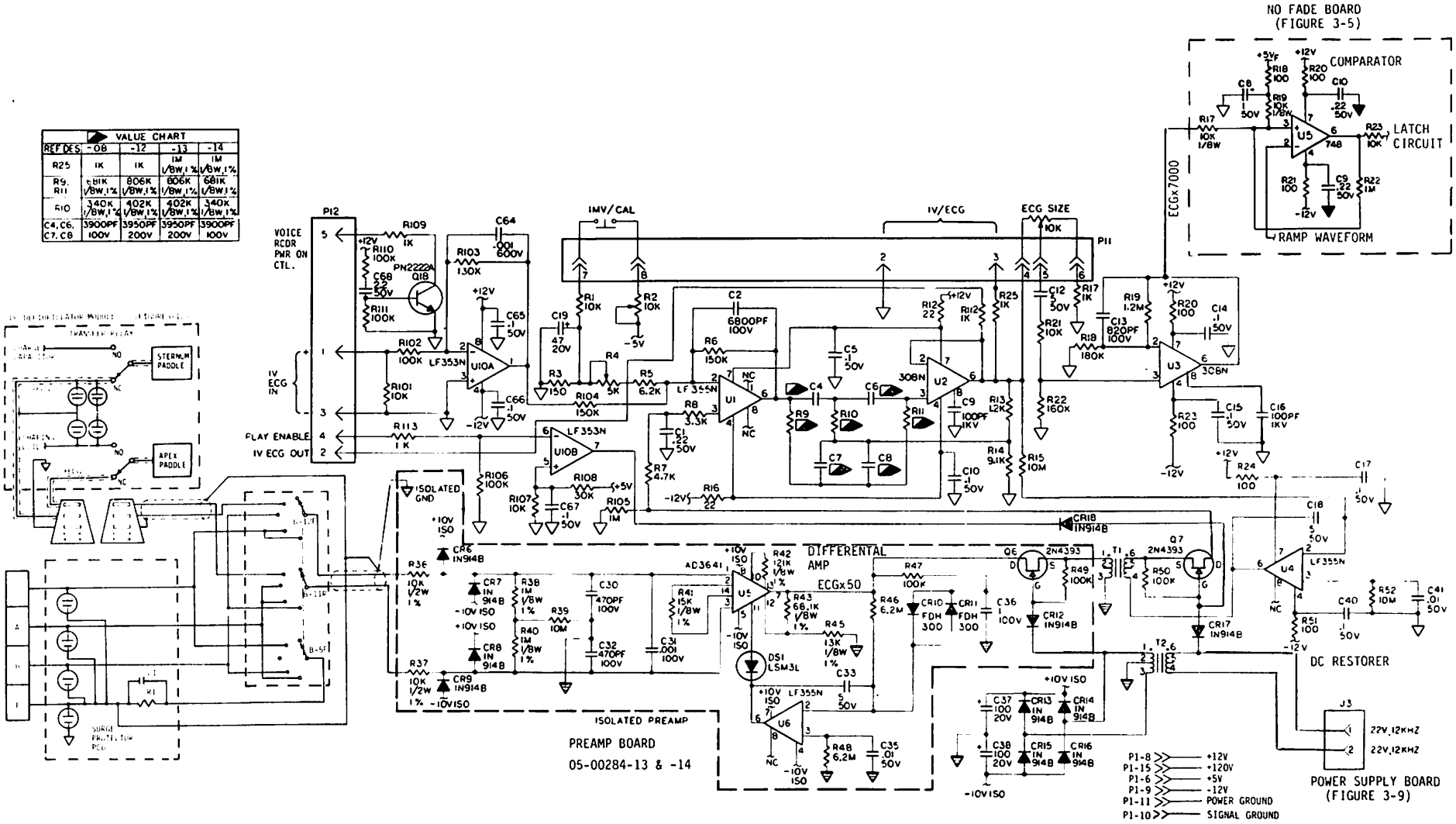


FIGURE 3-3. INPUT AND AMPLIFIER CIRCUIT
(SHEET 1 OF 2)

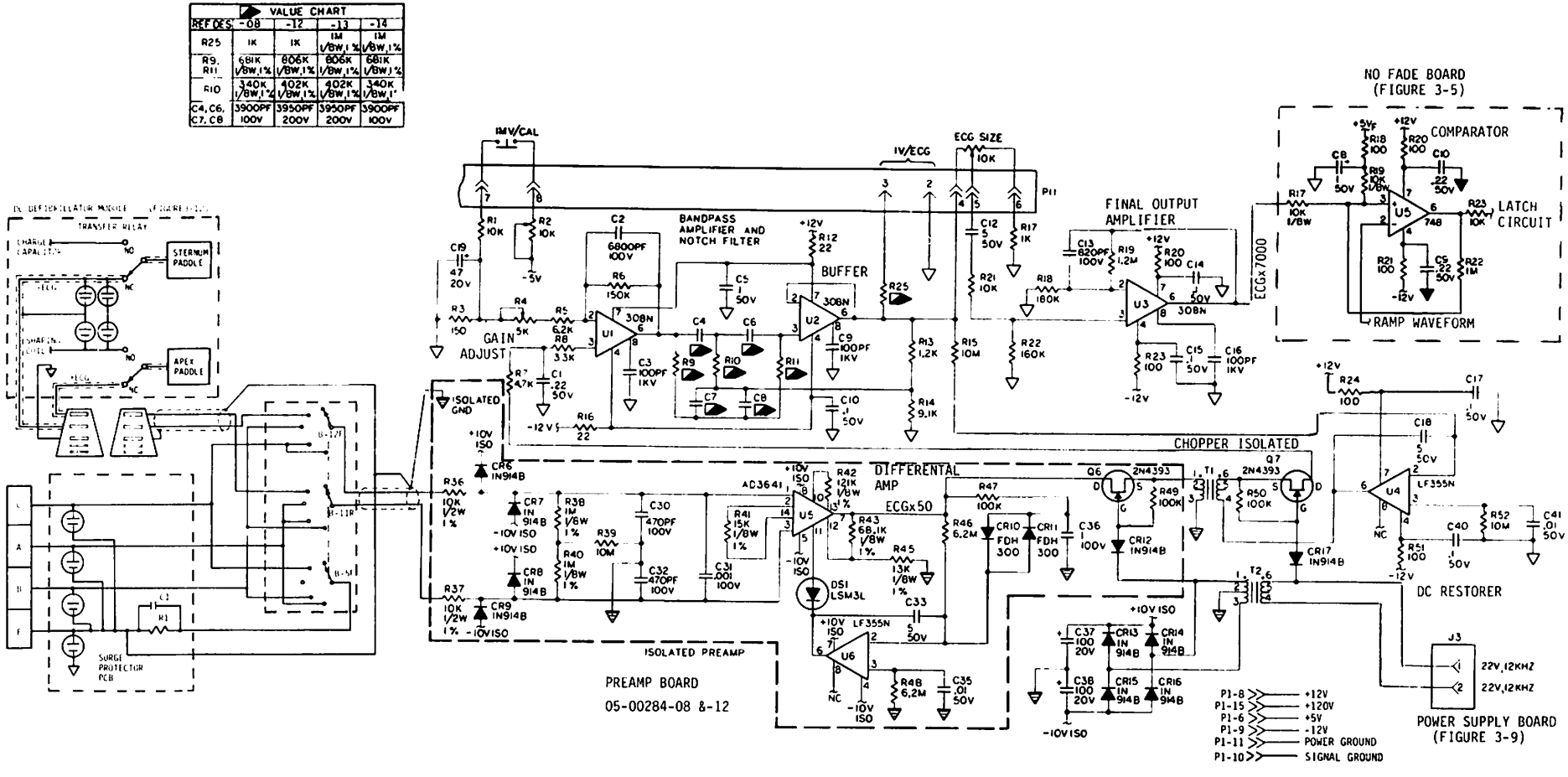


FIGURE 3-3. INPUT AND AMPLIFIER CIRCUIT
(SHEET 2 OF 2)

3-9. Bandpass Amplifier and Notch Filter. The restored ECG signal at the input of operational amplifier U1 is a normal positive going R-wave. U1 and its associated circuitry establishes a 43Hz roll-off frequency. Voltage gain through U1 is nominally 20. The twin T, active 60Hz notch is determined by the network consisting of R9 through R11, C4, C6, C7 and C8. The filter has approximately 45dB rejection at 60Hz. The notch is made narrow through the use of feedback through divider R13 and R14, and operational amplifier U2 to the common side of the filter. This scheme also minimizes attenuation through the filter in the flat portions of its response curve. The bandpass filter has no adjustment. Gain pot R4 is used to set the gain of the amplified ECG signal to 1000 and must be done before the 1mV CAL is adjusted. Operational amplifier U2 also provides a buffered output to the ECG OUT jack. A nominal 1mV p-p patient generated signal is amplified to a 1V p-p value at this point.

3-10. ECG SIZE and Final Output Amplifier. The ECG SIZE potentiometer, located on the control board, is used by the operator to set the ECG signal amplitude simultaneously to the vertical amplifier of the CRT and the recorder pen motor via the no-fade circuit. Operational amplifier U3 provides the final stage of amplification before the ECG signal is sent to the No-Fade Circuit (paragraph 3-12). Voltage gain through U3 is nominally 7.

3-11. ECG/Voice Recorder Circuit (Optional Equipment Controls). In addition to the circuits described previously for conditioning the ECG signal from the patient, the ECG Preamplifier PCB Assembly also carries circuits that are used with the Optional ECG/Voice Recorder P/N 801595.

The circuits perform three basic functions: to turn on the cassette recorder automatically when the monitor unit is switched on; to supply a standardization signal (1mV/V) to the recorder while the monitor displays the ECG signal; and to inhibit the patient's ECG signal while the taped ECG signal is displayed on the monitor CRT during playback.

A. Playback Circuit.

Two operational amplifier stages are used to accomplish these features. These are U10A and U10B, and a transistor circuit Q18. The U10A circuit is an ECG signal conditioning amplifier for playback of the taped ECG. It is an inverting amplifier with a low frequency gain of -1.3 which, in conjunction with the output impedance of the recorder drive circuit and the 10K ohm input to ground (R101), yields an output amplitude which is identical to the signal appearing at the ECG OUT jack on the unit. The circuit stage U1 is arranged so that the played back ECG is summed into the normal ECG signal path at that point, with the original ECG polarity restored at the output of U1.

B. Play Control Circuit.

U10B generates display control logic which selects the patient cable or cassette recorder inputs to be shown on the monitor CRT display. A Play Control logic signal is provided to U10B through the special interconnect from the cassette recorder. This signal is compared to a +1.25Vdc reference on the non-inverting input to U10B. A "Play"

3-11. ECG/Voice Recorder Circuit (Optional Equipment Controls). (Continued)

B. Play Control Circuit. (Continued)

signal below +1.25Vdc results in a positive-railed op-amp output; a "Play" signal above this level causes a negative-railed op-amp output. This output is connected through a diode to the gate of the isolation "chopper" transistor, Q7. When the gate goes negative the ECG signal from the patient cable is blocked to prevent its display on the monitor CRT during playback of the taped ECG. Positive op-amp rail has no effect on the operation of Q7 and the ECG signal from the patient cable is gated to the CRT display.

C. Calibration Signal.

1mV calibration pulses may be superimposed at will on the played-back ECG signal, since the signal is injected before the calibration pulse is introduced. The controlled gain ensures that the pulses indicate the ECG size at the time of recording.

D. Power-On Control Circuits.

When the ECG monitor is turned on, a circuit is employed which momentarily grounds a control line. This is achieved by a simple circuit based on the transistor, Q18. This is a one-shot circuit which pulls the collector of Q18 low for 250ms immediately after the ECG monitor is switched on. The capacitor C68 and resistor R110 in series with the base input of Q18, determine the 250ms time interval. Once capacitor C68 is charged, base drive stops and the one-shot restores. The time is sufficient for the recorder power to turn on, recognize that it was turned on by the monitor control line, select the record mode, and latch its own power.

E. ECG Monitor and the ECG/Voice Recorder Interconnect.

All the cassette recorder interconnect signals are provided through its connector P12 on the 05-00284 Preamplifier PCB Assembly. The five pins of this connector and the 04-50083 Wire Harness Assembly are used as a communication link between the ECG Monitor Unit and the ECG/Voice Recorder.

The functions provided are: 1V inputs and outputs (three lines including the ground connection); the recorder auto power-on control (one line); and the "Play logic" to the Preamplifier (one line). If an ECG/Voice Recorder is not used, these various signal and control lines will revert to the states required for normal LIFEPAK 5 Monitor operation.

3-12. No-Fade Circuitry. The following paragraphs describe the No-Fade Circuitry including a general overall description followed by detailed circuit analysis.Figure 3-4 provides a No-Fade Circuitry - Block Diagram

3-12. No-Fade Circuitry. (Continued)

showing interface with other stages. For more details, Figure 3-5 provides a No-Fade Circuitry - Schematic Diagram.

3-13. General. The no-fade circuit is divided into two main functional parts: the timing and control pulse generator and the converter and memory circuits. When power is applied to the instrument, a master oscillator continuously generates a 100KHz signal. This signal is used to drive the timing binary counter of the pulse generator circuit and the A/D binary counter in the analog-to-digital converter circuit. The ECG signal from the input and amplifier circuitry is fed into the comparator and compared to a reference voltage formed across the resistance ladder of the analog-to-digital converter. This reference voltage is generated by the A/D binary counter and takes the form of a positive-going staircase ramp. When the reference signal matches the incoming ECG signal, the binary gate blocks further pulses to the A/D binary counter and the reference voltage is held. This voltage, in the form of an eight bit digital word, is then transferred to the memory; the A/D binary counter is reset, and again the reference signal ramp is formed to match the incoming ECG signal. This process continues at a sample rate of 200Hz. Conversion from the digital word in the last stage of the memory to an analogous voltage occurs in the resistance network of the digital-to-analog converter. The words in the buffer memory are entirely circulated and synchronized with the CRT sweep so the contents of the memory are entirely displayed during each sweep. The contents are again run through during the retrace sweep, but not displayed. Thus, the instrument display of the ECG signal is updated at the rate of two words per sweep, one on display, one on retrace.

3-14. Timing Counter Circuitry. A frequency of approximately 100KHz generated by the master oscillator U11-A and B is used to produce timing and control signals for the no-fade circuit. This signal will be referred to as the clock pulse. The clock pulse is used to drive the timing counter U7. The clock pulse has two stable voltage levels which will be termed 0 for zero voltage level and 1 for positive level.

The clock pulse enters the timing counter U7-10 at the CLK input. The timing counter, U7 in this configuration, uses ten ripple-carry binary counter stages. The state of the counter is advanced one step in binary order on the negative-going (i.e., 1 to 0) transition of the clock pulse. Resetting the timing counter to the all-0's state is accomplished using the positive-going pulse obtained from one-shot multivibrator U3-A. U3-A is triggered from a normally negative-going pulse at the output of NAND gate U6-A pin 3. A second condition called the freeze mode is obtained by shorting R38 to U6A pin 3 via the FREEZE switch. This applies a positive 5V to U6-A-1 resulting in the write and recirculate signal being formed by U3-A every 512 clock pulses rather than every 513 clock pulses as in the run mode. This prevents substitution of memory words and continues to circulate the memory contents without any updated changes.

The clock pulses are fed to the memory clock driver U13 via two Schmitt triggers U11-C-10 and U11-D-6. R37 and C12 provide a delay between the memory clock pulses and the write/circulate pulses. The combination of

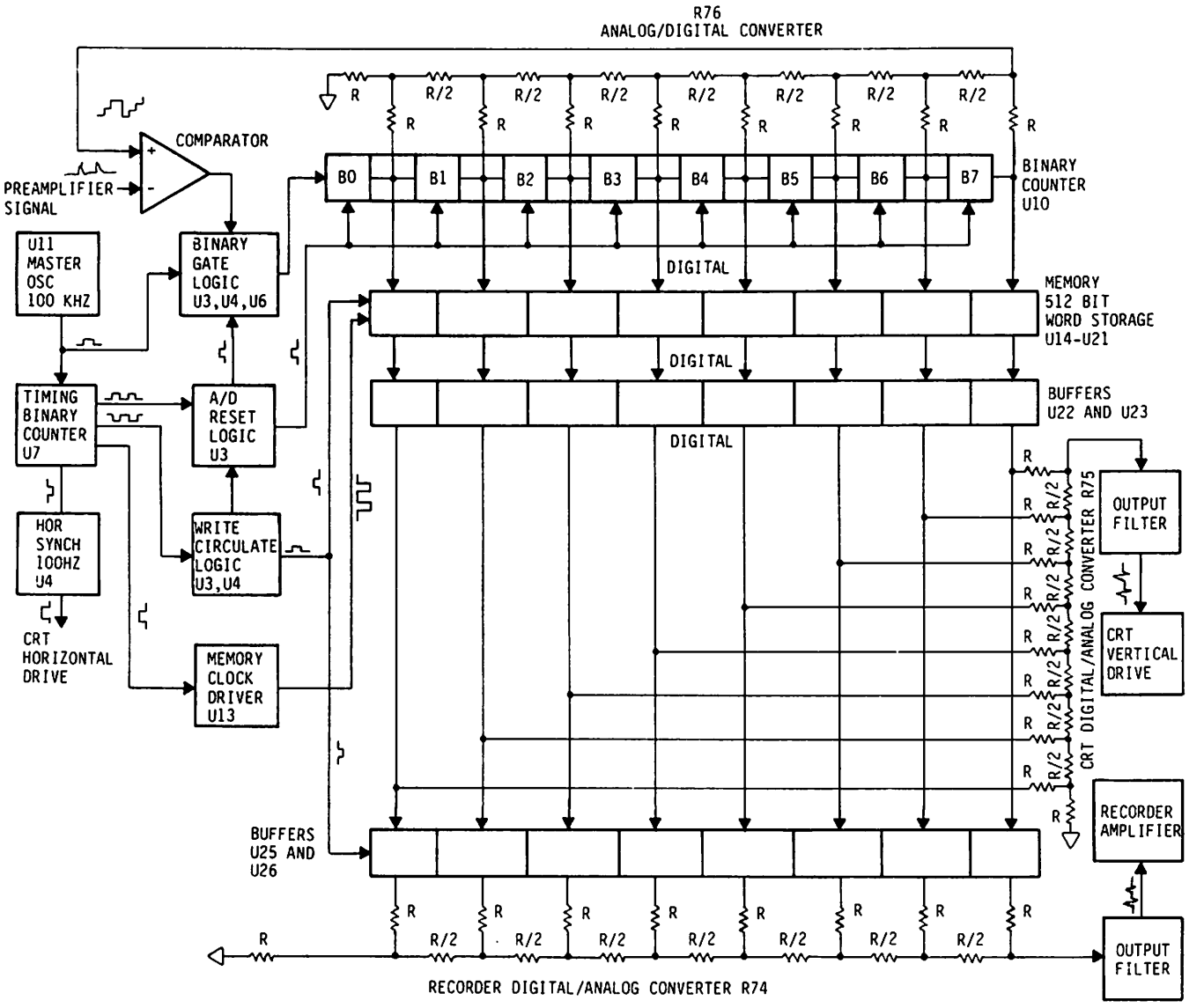


FIGURE 3-4. NO-FADE BLOCK DIAGRAM

3-14. Timing Counter Circuitry. (Continued)

the U3-A, U4-A, U6-A and U7 also provides the sweep generator with horizontal sweep input pulses of 100Hz and retrace blanking. R36 is used to set the period of the horizontal sweep to 10ms (100Hz).

3-15. A/D Circuitry. Clock pulses from the master oscillator are fed to the flip-flop U4-B-3 CLK input. These clock pulses are routed through U4-B to the A/D compare latch circuit where they are applied to the A/D binary counter U10. As utilized, the A/D binary counter U10 consists of eight input pulse shaping and ripple-carry counter stages. A master-slave flip-flop configuration is utilized for each counter stage. The state of the counter is advanced one step in binary order on the negative-going transition of the input pulse. All inputs and outputs are fully buffered. The outputs of the eight stages are routed to a resistance ladder network R76 where they are weighted according to their bit significance and summed. This sum, applied to the comparator U5-2, is a staircase voltage starting at 0V and rising to 255 steps of 19.6mV each.

As the staircase voltage ramp is rising, it is continuously compared with the ECG signal from the input stage applied to the comparator U5-3. At the point when the reference ramp matches the input signal, the output signal at U5-6 drops, U6-A-10 rises, U6-B-11 drops and U6-C-4 rises. This action latches the U6 network and blocks pulses from the clock to the A/D binary counter. Thus the A/D counter is stopped at the point where the resistive ladder R76 output voltage is the same as the input signal voltage from the input stage. The one-shot multivibrator U3-B is triggered from the trailing edge of the write recirculate pulse and an A/D reset signal from U3-B-6 is applied to the A/D binary counter U10-11 and to the flip-flop U4-B-4. Prior to this point, the original circuit conditions are restored, and the circuit is ready for another A/D conversion.

3-16. Memory Circuitry. All information displayed on the CRT or recorder has been stored first in digital form within the memory. The ECG signal is sampled continuously, and each time a sample has been taken, the signal at that instant is converted into a binary word and stored in the memory. The memory consists of eight 512 bit shift registers, U14 through U21. The last stage in the memory is connected to the first stage to form a continuous word train. Each output section of the shift registers is connected to a pull down resistor network R47. One end of R47 is connected to ground. The outputs of the shift registers are routed to eight buffer stages contained in stages U22 and U23.

The control for the memory is provided by the memory clock driver U13 acting in conjunction with the write recirculate signal. The opposite phase clock pulses developed from the Schmitt triggers U11-C-10 and U11-D-6 are fed to 4 buffer amplifier stages contained in U22. Two stages each of paralleled buffers U22 are used for each input of the clock pulse driver U13 to establish high current handling capability. Each word in the memory is circulated continuously from one stage to the next succeeding stage at the rate of approximately 10^5 words per second on command of the clock signals Q1 and Q2. The two signals are sequential and both are required to shift a stage.

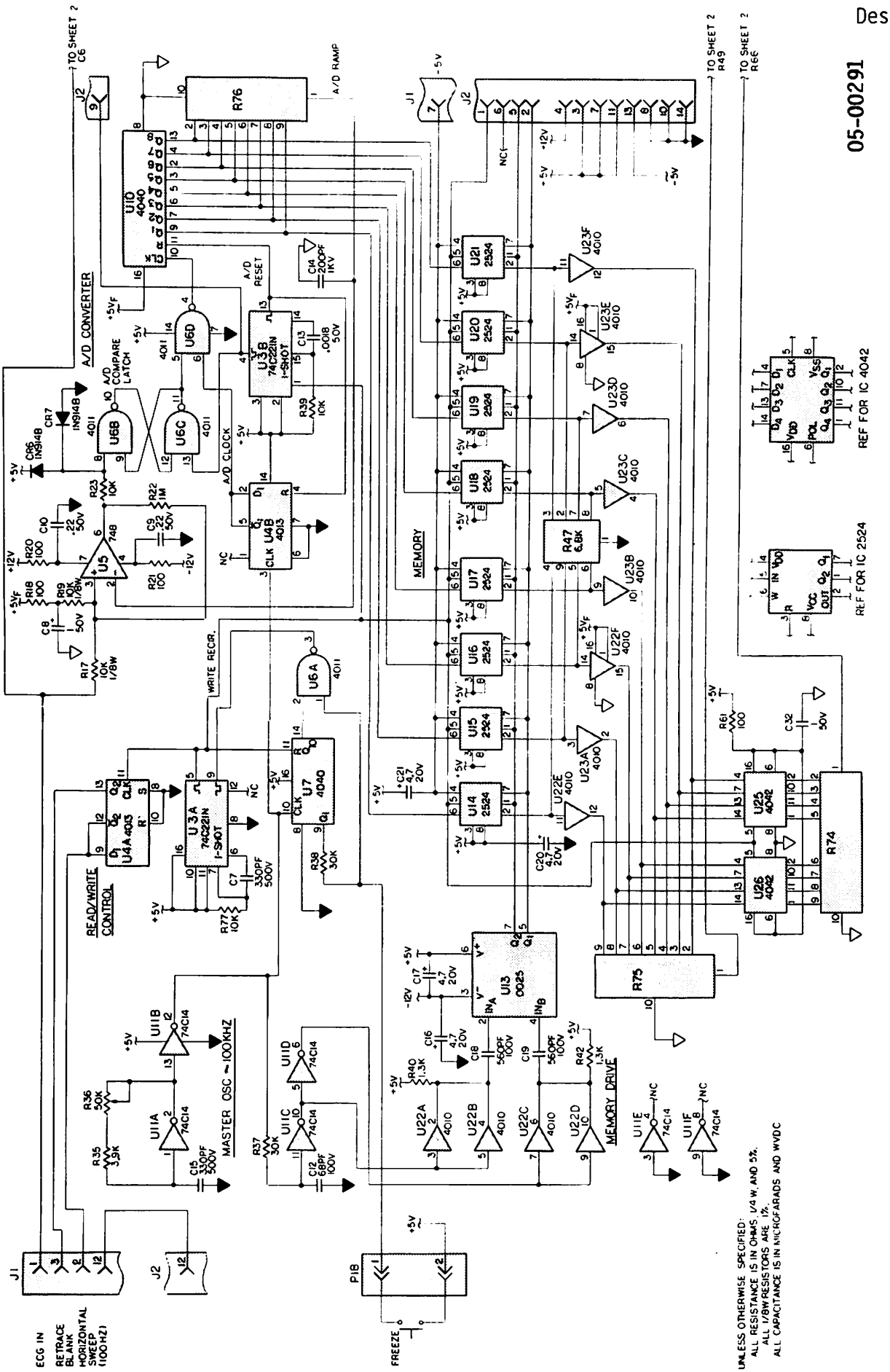


FIGURE 3-5. NO-FADE PCB SCHEMATIC (SHEET 1 OF 2)

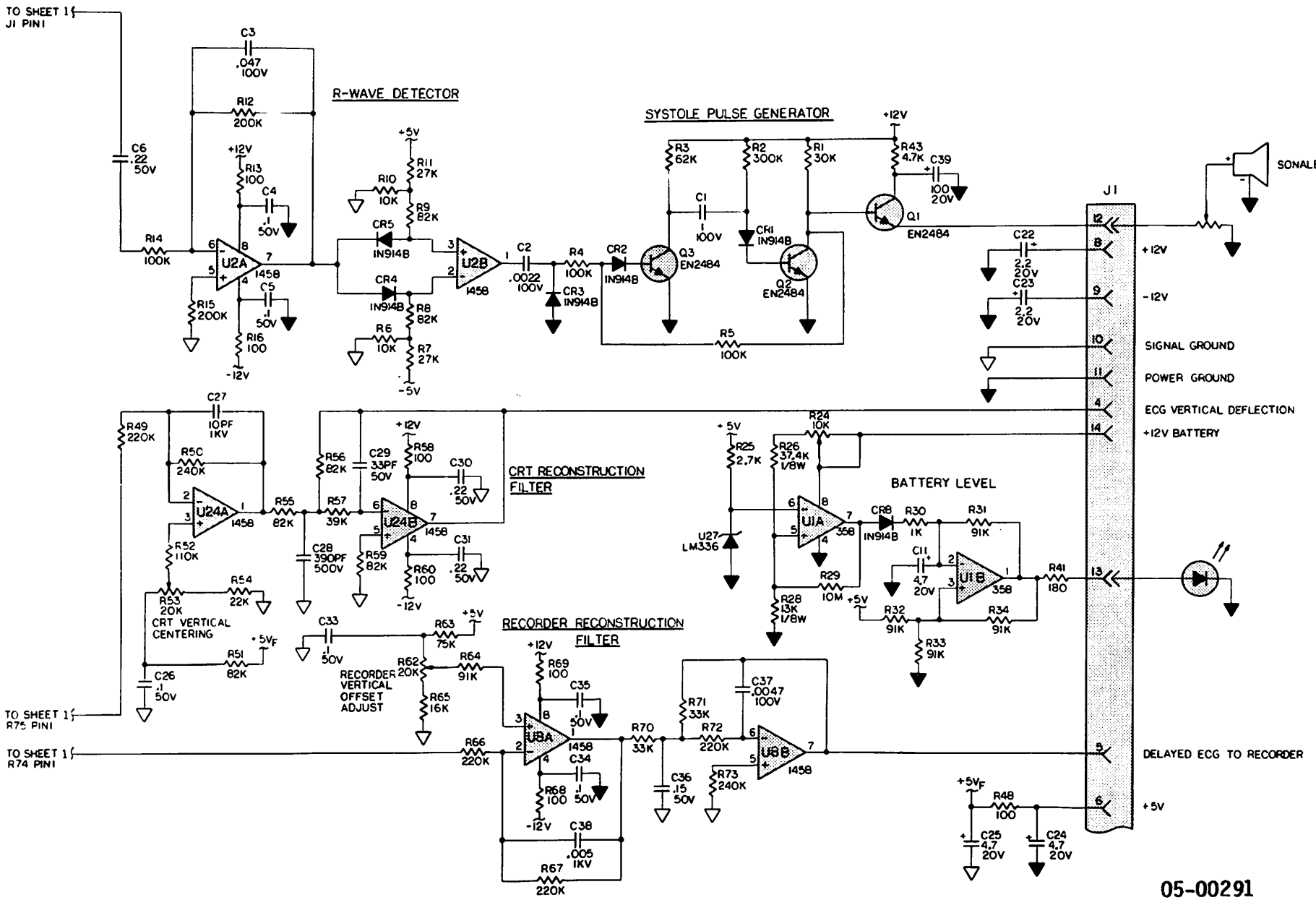


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FIGURE 3-5. NO-FADE PCB SCHEMATIC
(SHEET 2 OF 2)

3-17. D/A Circuitry. The output of shift registers U14 through U21 are fed through eight buffer stages contained in U22 and U23 to the CRT vertical D/A resistive ladder R75 and to eight stages of recorder buffers contained in U25 and U26. These buffers (U25 and U26) contain four latch circuits each and are strobed by a common clock. The clock pulses at U25-5 and U26-5 are obtained from the write recirculate signal. This latches the oldest sample in memory for eventual display on the strip chart recorder, resulting in a normal 2.4 second delay record mode. Depression of the FREEZE pushbutton switch shifts the write recirculate signal one count such that the newest sample in memory is used in record, this provides a "real time" mode. The outputs of these buffers are then routed to D/A resistive ladder R74.

The D/A resistive ladders R74 and R75 convert the digital data into an analogous voltage without affecting the digital integrity of the word. The analog signal is then applied to the CRT vertical amplifier and recorder amplifier circuits (refer to paragraphs 3-18 through 3-24).

3-18. ECG Monitor Display Circuitry. The following paragraphs describe the ECG Monitor Display Circuitry, including Vertical, Horizontal and timing circuits. Figure 3-6 provides a complete schematic of the ECG Monitor Display Circuitry to assist in the following detailed circuit analysis. Operating voltages are derived from the system power supply presented in paragraph 3-26.

3-19. Vertical. An analog output from the A/D resistance ladder R75 in the no-fade circuit is fed to one stage of operational amplifier U24-A-2 (No-Fade PCB) where it is referenced to the voltage from the CRT centering network of R53. This voltage is applied to U24-A-3. Adjustment of R53 changes the reference voltage and determines the vertical position of the CRT trace. The second stage of U24B provides low pass filtering. The ECG size potentiometer located on the control board controls the amplitude of the ECG signal to both the CRT and recorder via the No-Fade Circuitry (refer to paragraph 3-12).

Two stages of operational amplifier U9-A and B (Preamp PCB) in conjunction with the differential amplifier Q15 and Q16 (Preamp PCB) provide vertical deflection for the CRT. Retrace blanking is provided by driving the display vertically off the CRT through Q17. The signal at U9-B-1 is equal in amplitude and 180 degrees out of phase with that of U9-A-7. The differential amplifier has a gain of approximately 14. The retrace blanking timing signal is derived from the timing counter stage on the No-Fade PCB.

3-20. Horizontal. A horizontal sweep timing pulse of 100Hz, derived from the timing circuitry on the No-Fade PCB, is applied to operational amplifier U7-2 (Preamp PCB) which is connected as an integrating amplifier. The horizontal sweep timing pulse is adjusted with R36 (horizontal timing) on the No-Fade PCB. The timing pulse is referenced to the voltage from the horizontal positioning network of R68. Adjustment of R68 changes the reference voltage and determines the horizontal positioning of the CRT trace. A triangle waveform is developed by U7 and R63 (horizontal sweep gain) is adjusted to provide a 25mm/sec sweep. This waveform is applied

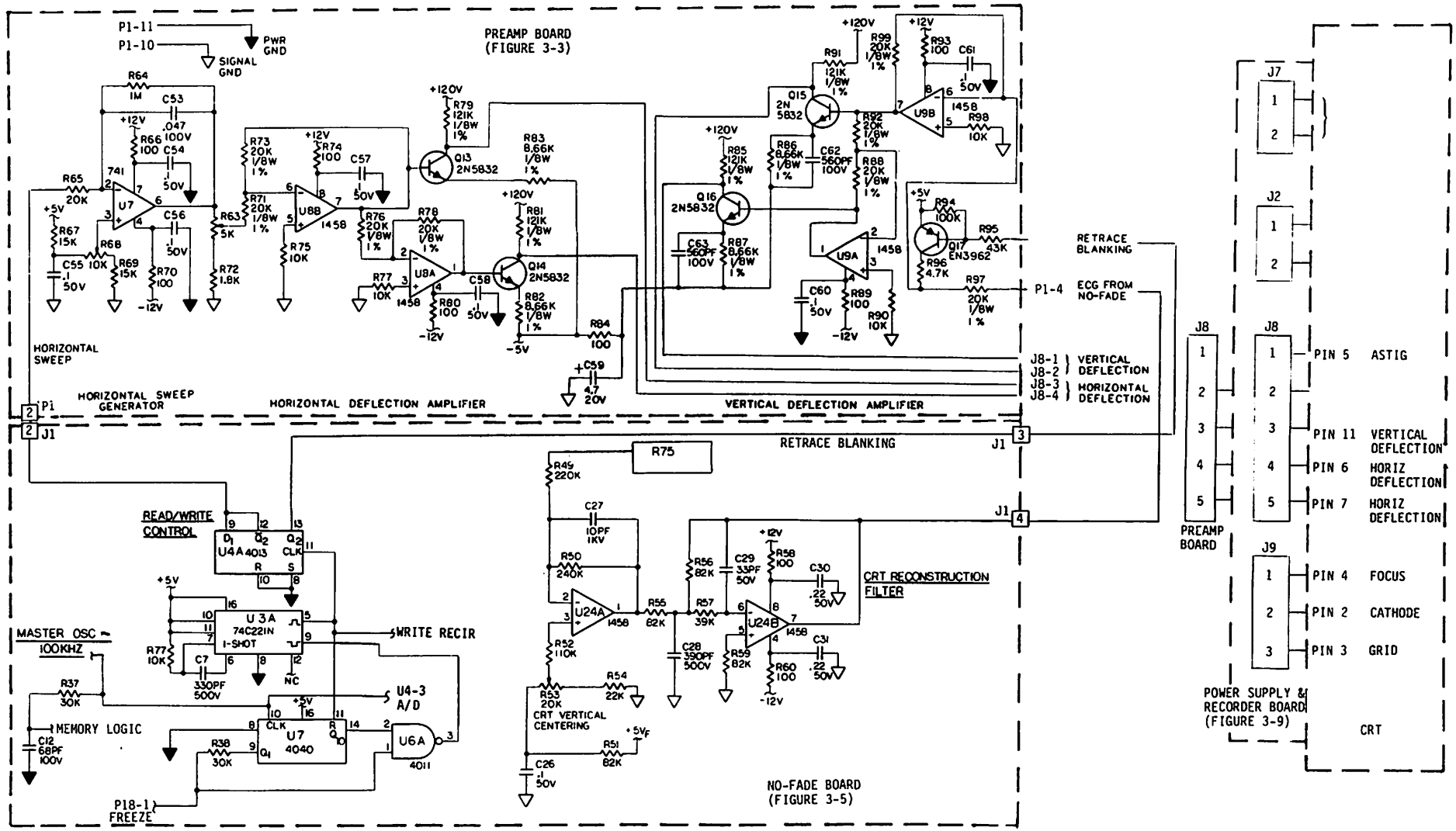


FIGURE 3-6. ECG MONITOR CIRCUIT

3-20. Horizontal. (Continued)

to the horizontal deflection plates of the CRT through the differential amplifier composed of the two sections of operational amplifier U8-A and U8-B driving Q13 and Q14.

3-21. Recorder Display Circuitry. The recorder circuitry receives its ECG input from the D/A resistive voltage divider R74 (No-Fade PCB). Its amplitude, like that of the CRT vertical, is adjusted by the ECG SIZE pot. When the recorder is not in use it is turned off to conserve energy. Figure 3-7 provides a detailed schematic to assist in the following circuit analysis.

3-22. Offset and Signal Conditioning. The outout signal at resistive ladder R74 is fed to the operational amplifier U8-A-2 (No-Fade PCB) inverting input where it is referenced against a voltage formed by the network R63, R62, and R65. R62 (recorder offset adjust) is adjusted to null any offset at U8-A-1. Operational amplifier U8-B forms a low pass filter and its output is routed to amplifier U2 on the Power Supply and Recorder PCB.

3-23. Pen Motor Amplifier. The incoming signal from the low pass amplifier U8-B on the No-Fade PCB is amplified in operational amplifier U2 which drives the complementary-symmetry push-pull output stages Q6-Q7 and Q5-Q8. The combination of voltage and current feedback is designed to optimize the frequency response of the recorder. Recorder gain potentiometer R11 adjusts the magnitude of the feedback signal to U1-2.

3-24. Recorder Inverter, Stylus Heat and Paper Drive Motor. The square wave from the Royer oscillator (T2, Q9, Q10) is rectified and filtered to supply -12V for the recorder pen motor circuit (refer to paragraph 3-28). The stylus heat voltage is developed from the 12Vdc battery, timer U1 and Q2 varies the duty cycle from 16 to 25%. The stylus HEAT potentiometer provides duty cycle adjustment capability. Operational amplifier provides a dc voltage to the paper drive motor. The paper drive motor's speed is adjusted for 25mm/sec by R15 (timing adjust). The paper drive circuits are designed to maintain a constant motor speed regardless of normal loading effects on the motor.

3-25. Systole Sound Circuitry. The circuit consists of an R-wave detector which is used to time the generation of a square pulse on the down slope of the R-wave. The output pulses the systole sound transducer. Figure 3-8 provides a schematic to assist in the following detailed circuit description.

The Systole Sound Circuitry receives its input from the final amplifier on the Preamp PCB. The input R-wave can be either positive or negative going, therefore a bipolar detection is used. It passes through narrow-band filter C6, R14, C3 and U2-7 (No-Fade PCB). The signal is centered on about 11Hz to emphasize the R-wave and deemphasize the T-wave which might otherwise falsely trigger the detector. The reference voltage at U2-3 or U2-2 determined by R9 through R11 or R6 through R8 is set so that the trailing edges of the negative-going square pulses at U2-1 or R6-R8 occur high upon the down slope of the R-wave.

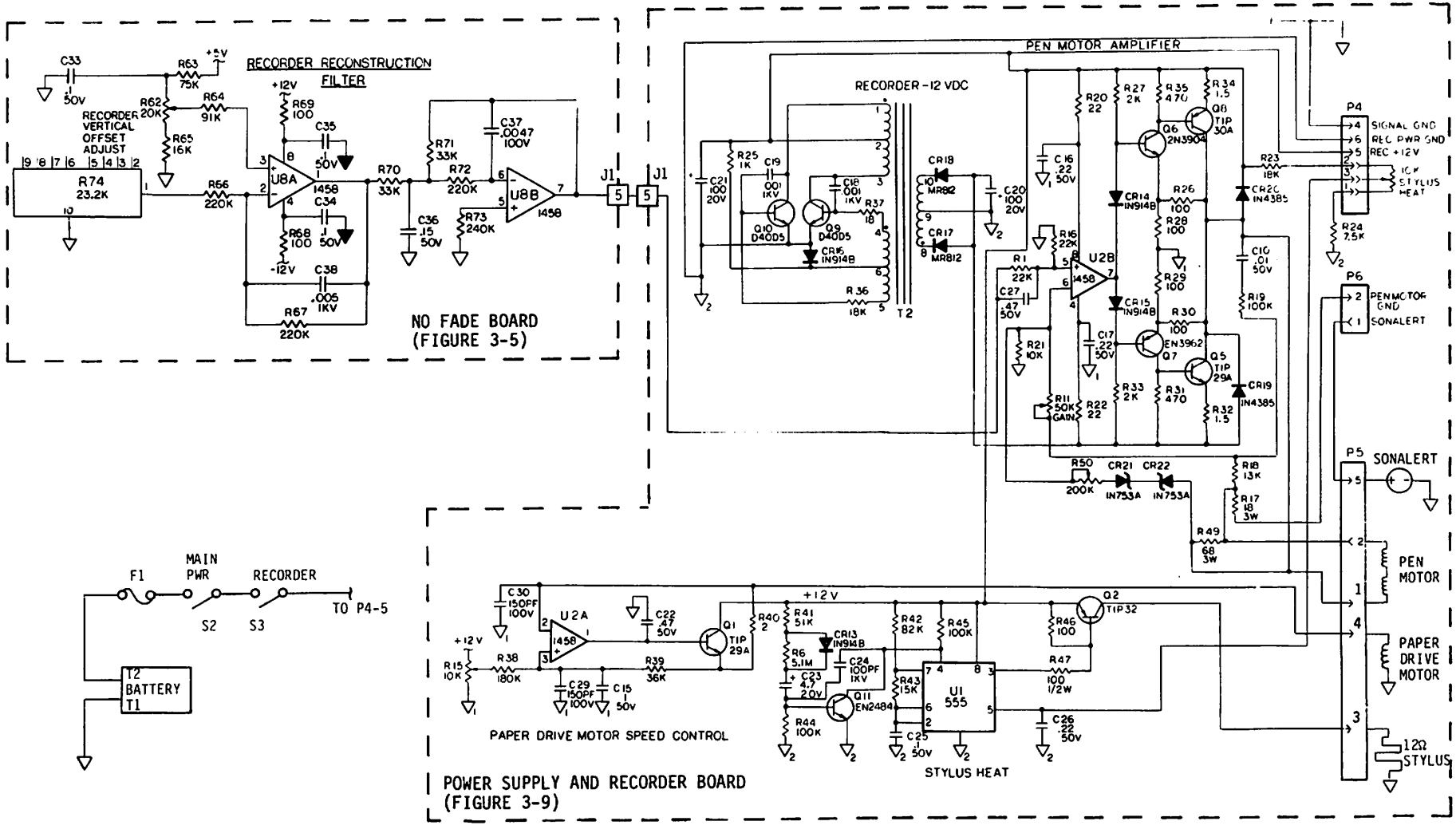


FIGURE 3-7. RECORDER CIRCUIT

3-25. Systole Sound Circuitry. (Continued)

The train of square pulses, applied across CR3, loses practically all of the negative-going swing while retaining a sharp positive spike. The spikes are used to trigger the one-shot multivibrator Q2 and Q3. The positive-going pulse train at the collector of Q2 is buffered by Q1. Each time Q2 turns off it turns on Q1, applying a pulse across the SYST VOL pot R3. The SYST VOL pot R3, located on the control board is used to adjust the audio level of the sonalert. The sonalert is physically located in the recorder unit.

3-26. Power Supply Circuitry. The following paragraphs describe the Power Supply Circuitry including the Royer Oscillator, Isolated Power, ±12V, ±5V, +120V Supply and CRT Operating Voltages. Figure 3-9 provides a schematic to assist in the following detailed circuit analysis.

3-27. General. The ECG Monitor/Recorder is powered by a 12V, rechargeable, nickel-cadmium battery. The 12Vdc is applied through the Power/Mode Select pushbutton switch S2, located on the control board, to P10-2 and P10-1. The power supply circuit is protected by a one amp fuse F2. This voltage is sensed by the Low Battery Level Circuitry (paragraph 3-34).

The 12Vdc, for all circuits except the recorder, is then applied to a three terminal 8V regulator U3. The regulator employs internal current limiting, thermal shutdown, and safe area compensation, making it essentially blowout proof.

The regulator is mounted on a heat sink, which connects pin 3 to ground. Pin 1 provides the input and pin 2 the output to the Royer oscillator. For the Recorder, the 12Vdc from the battery is applied through the Power/Mode Select pushbutton switch S2 and RECORD power pushbutton S3. The Recorder circuitry is protected by a 2A fuse F1. The 12Vdc enters the Power Supply and Recorder PCB through P4-5 (+) and P4-6 (pwr gnd) to the recorder Royer oscillator.

3-28. Royer Oscillator. Two Royer oscillators are provided; the following description is applicable for both. All circuitry except the recorder is supplied by the oscillator using T-1. The numbers in parentheses represent the recorder Royer oscillator. The oscillator runs at about 12KHz (16KHz). The bases of switches Q3 and Q4 (Q9 and Q10) are driven in phase opposition by winding T1-4 and 6 (T2-4 and 6) on transformer T1 (T2). The center tap of T1 is held at 8Vdc by regulator VR1 while the ends of the winding are alternately shorted by switches Q3 and Q4.

Switching from one pulse of the square wave to the other occurs when the magnetic flux in the core of T1 (T2) reaches the saturation level, whereupon the drive to the base of the on switch Q3 or Q5 (Q9 or Q10) declines and begins to turn off that switch, causing the flux in the core to diminish and begin building up in the opposite direction. The process is continuous as long as power is applied to the circuit. The output signal across the collectors of Q3 and Q4 (Q9 and Q10) is a 12KHz (16KHz) square wave of approximately 16V (24) amplitude.

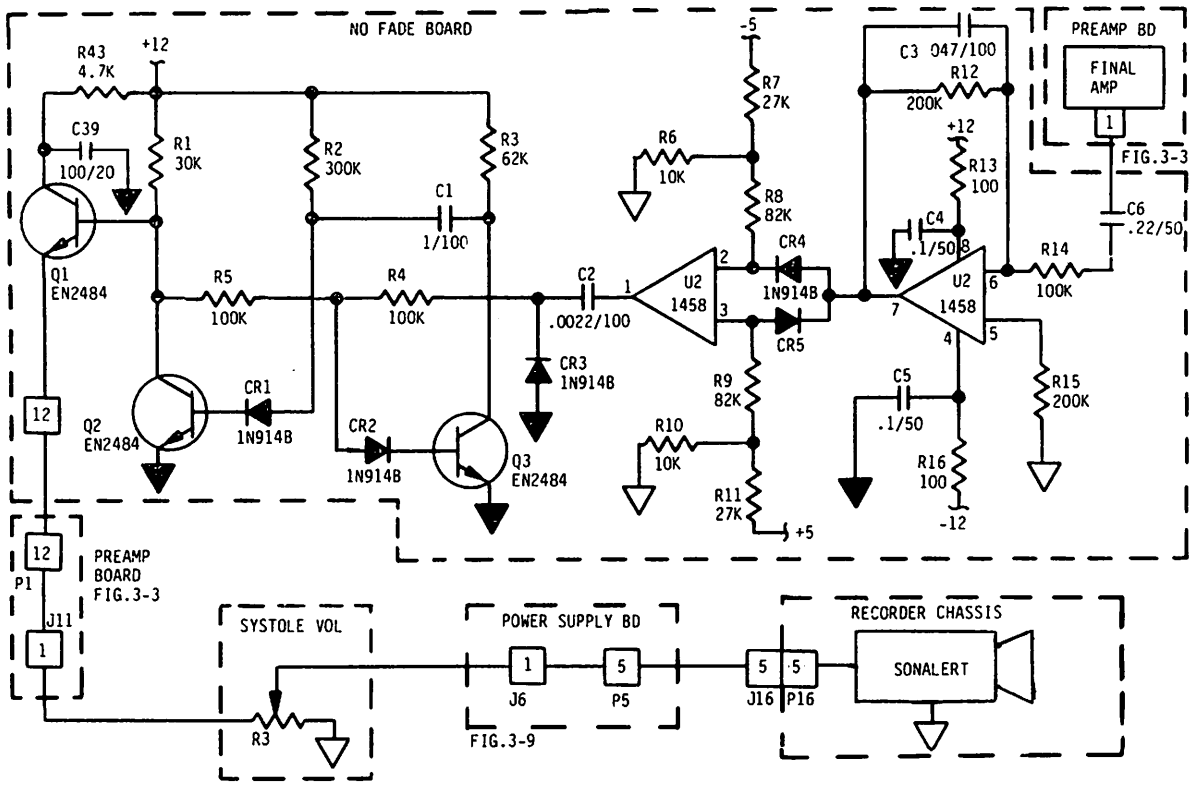


FIGURE 3-8. SYSTOLE SOUND CIRCUIT

3-29. Isolated Power Supply. To protect the patient against electric shock, the electrodes of LIFEPAK 5 which contact the patient are isolated from continuity with electrical power and earth ground. ECG signals are amplified in the isolated preamp, then transformer coupled to the other circuitry of LIFEPAK 5. Plus and minus 12V power to operate the isolated preamp circuitry is produced by full-wave rectifier CR13 through CR16 and filters C37 and C38, which are mounted on the Preamp PCB (see Figure 3-3). The input power to this bridge is coupled through T1 on the Power Supply PCB to P3-1 and P3-2 and is 24V p-p.

3-30. ±12V Supply. Plus and minus 12V is delivered to the ECG Monitor/Recorder circuitry (except recorder) from a full-wave bridge consisting of CR1 through CR4 and filters C1 and C2. The 24V p-p input to this bridge from the Royer oscillator is applied across the T1 secondary at pins 12 and 16. The plus and minus 12V is routed out of the bridge through J1-8(+), J1-7(-) and J1-6 (power ground).

The Recorder -12V is derived from T2 primary pins 10 and 8. CR17 and CR18 and C20 full-wave rectify and filter the voltage at T2 secondary.

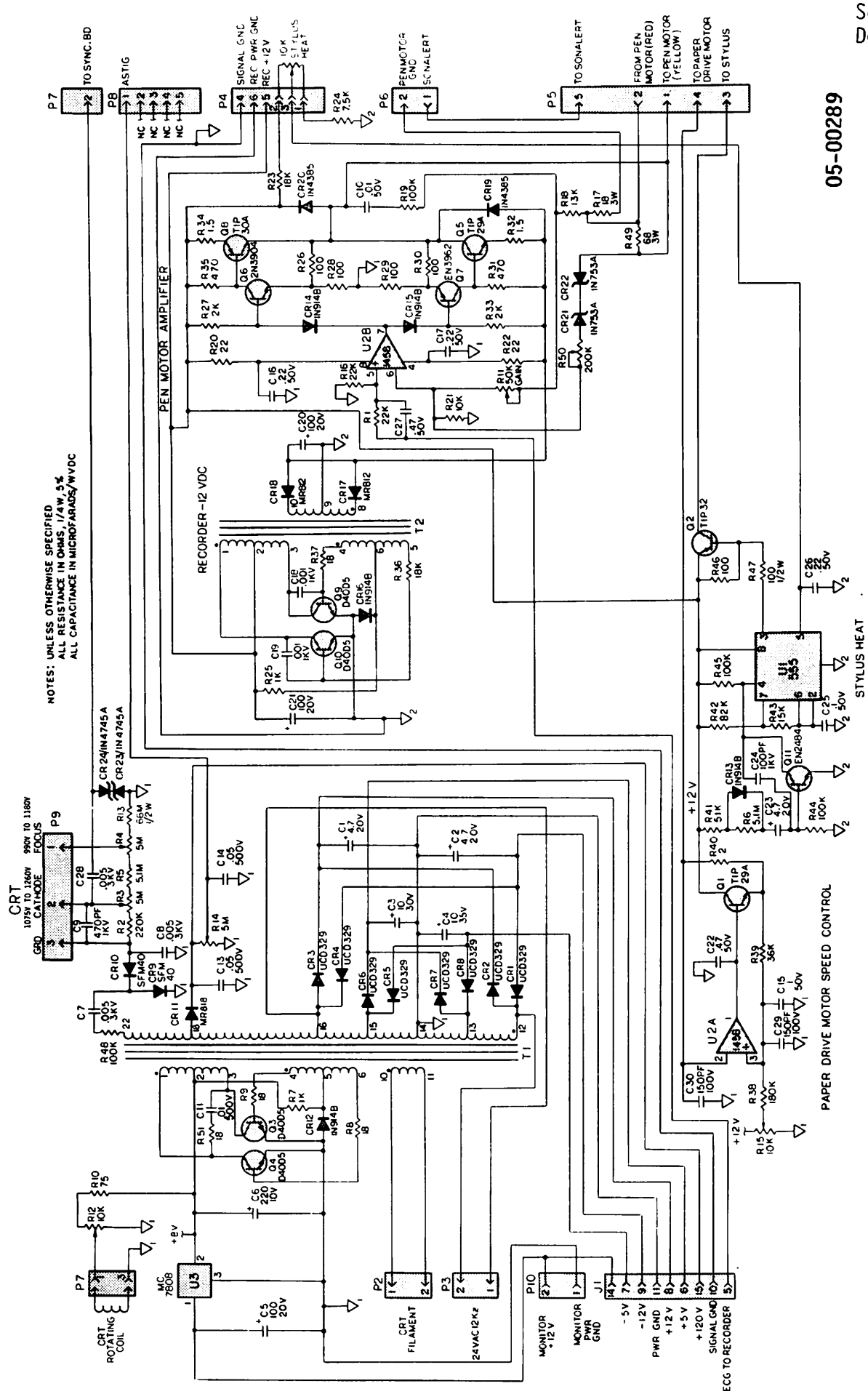


FIGURE 3-9. POWER SUPPLY/RECORDER PCB SCHEMATIC

3-31. ±5V Supply. Plus and minus 5V is delivered to the ECG Monitor/Recorder circuitry from a full-wave bridge consisting of CR5 through CR8 and filters C3 and C4. The 10V p-p input to this bridge from the Royer oscillator is applied across the T1 secondary at pins 15 and 13. The plus and minus 5V is routed out of the bridge through J1-6(+), J1-7(-) and J1-11 (power ground).

3-32. +120 Volt Supply. The CRT horizontal and vertical drive circuits require +120V. The +120 volts between T1-14 and T1-18 is rectified and filtered by CR11 and C13. This voltage is routed to the vertical and horizontal drive circuits through J1-15(+) and J1-11 (power ground).

3-33. CRT Operating Voltages. Refer to Figure 3-6 for a ECG Monitor Circuitry Schematic Diagram. CRT operating voltages are developed as follows:

A. CRT Filament. 6.3VAC filament voltage is supplied to the CRT through P2-1 and P2-2.

B. ASTIG. Astigmatism voltage for the CRT is developed from the +120V Supply. Potentiometer R14 is provided for adjustment. The voltage is routed out on P8-1(+) and J1-11 (power ground).

C. GRID, CATHODE AND FOCUS. -1300V p-p is supplied across T1-22 and T1-14 from the Royer oscillator. This voltage is rectified, filtered and doubled by CR9, CR10, and C7. The output of this network is 1300Vdc and is routed to the grid through P9-3. -1300 Vdc is also applied to the voltage divider consisting of R2, R3, R4, R5 and R13 which provides cathode and focus voltages. R3 provides adjustment for the cathode voltage (intensity adjustment) and R4 for the focus voltage. The cathode voltage is routed out through P9-2 and the focus voltage through P9-1.

D. CRT Rotating Coil. CRT rotating coil voltage is developed from the 8V voltage regulator U3 output. It is adjustable through R12. The voltage is routed out through P7-1(+) and P7-3 (power ground). The current through the rotating coil is used to align the CRT trace with its horizontal axis.

3-34. Low Battery Level Circuitry. Refer to Figure 3-10 while reading the following circuit analysis. One stage of operational amplifier U1 functions as a comparator amplifier. Reference voltage obtained from the +5V Supply is fed through voltage reference circuit R25 and U27 to U1-A-6(-). This 2.5V reference voltage is compared with that of the 12Vdc instrument battery supplied to U1-A-5 through voltage divider network R24, R26, and R28 and the reference voltage at U1-C-6. The output voltage at U1-A-7 will go low when the battery level drops below 10.0Vdc.

The second stage of U1-B functions as an oscillator and drives the low battery indicator. This indicator will flash when the battery terminal voltage is nominally 10.0V at 25°C. When the voltage is low at U1-A-7 the oscillator stage is allowed to run and flashes the indicator.

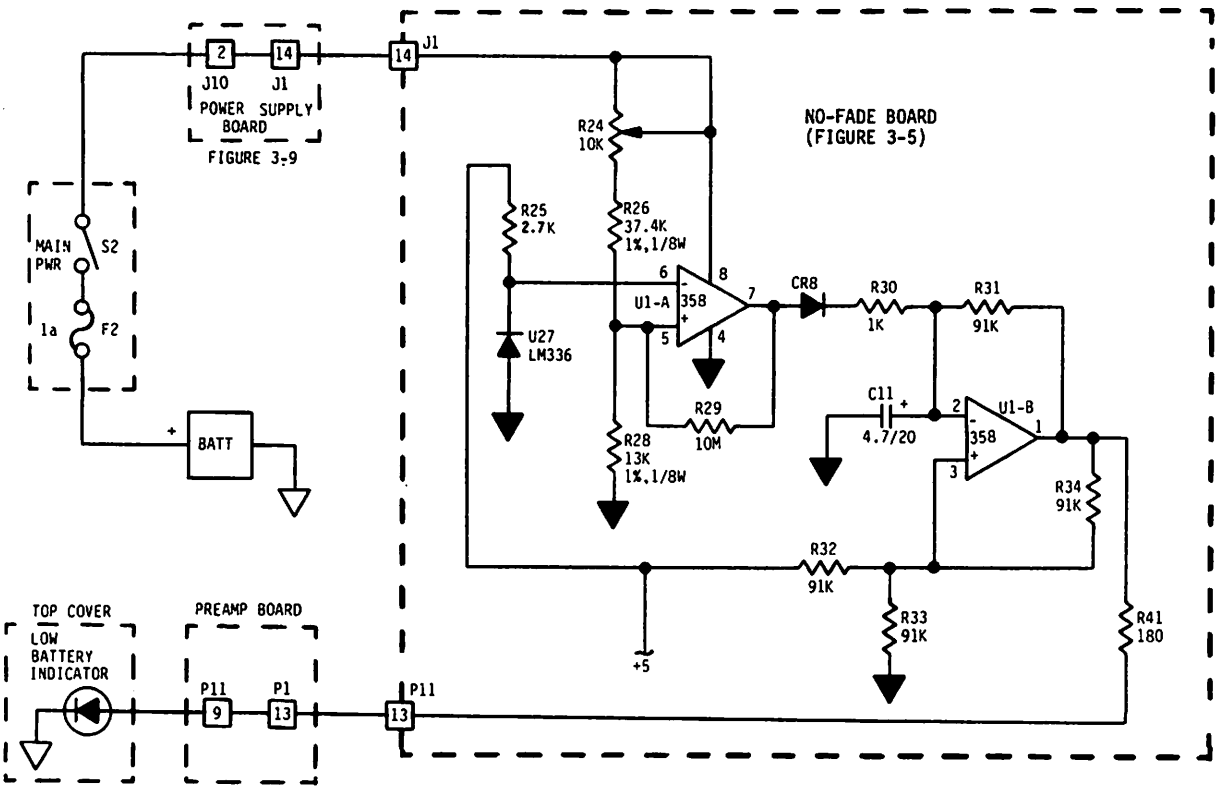


FIGURE 3-10. LOW BATTERY LEVEL CIRCUIT

3-35. DC DEFIBRILLATOR UNIT

The DC Defibrillator Unit circuit description is presented by circuit function. A functional or block diagram description begins the first part of this section. The remaining part is a detailed description of the circuitry within the DC Defibrillator unit. The Defibrillator Wire Harness Assembly presented in Section 5 provides complete interconnection data for the sub-assemblies of the Defibrillator Assembly.

3-36. Functional Description. The DC Defibrillator Unit Block Diagram presented by Figure 3-11 provides an overall view with signal flow. For a more detailed analysis, Figure 3-12 provides a complete Defibrillator PCB Schematic.

When power is applied and the CHARGE button depressed, the charge control logic circuit initiates several commands. The main command is to enable the charge up circuitry to charge the charge storage capacitor. Simultaneously the charge control logic causes the Charge Indicator to flash, meaning the charge storage capacitor is being charged. The dump relay is energized by the dump control causing the dump resistor to be removed from the charge storage capacitor. The charge control logic also initiates the transfer disable signal so that the transfer control cannot be enabled, thus rendering the paddle buttons ineffective until the charge storage capacitor has reached full charge. Once the charge storage capacitor has reached the charge set by the ENERGY JOULES, select switch S4, the ready comparator signals the charge control logic. The charge control logic disables the charge up circuitry and defeats the transfer lockout disable signal circuitry. At the same time, the ready comparator changes the flashing indicator light to a steady light, signifying the instrument is ready. Depressing the paddle Discharge buttons S2 and S5 at this time causes the transfer control to energize the transfer relay. With the relay energized, the charge path is opened and the discharge path completed for transfer of the stored energy to the paddles. At this time the dump relay is deenergized and places the dump resistor across the charge storage capacitor.

3-37. On/Off Circuitry. The on/off circuit toggles the input power off and on and sets up initial conditions within the DC Defibrillator Unit. The major components of this circuitry include U5-A and B, a data-type flip-flop, transistors Q8 and Q11, POWER switch S3, and the on/off relay K1.

The first stage of U5-A functions as a one-shot multivibrator which turns transistor Q8 on long enough to precharge C1 before the on/off relay is energized. The quiescent state of U5-A's S(set) and R(reset) inputs are both high and the $\overline{Q}$ output (12) is high, therefore Q8 is off. When the POWER switch S3, located on the sternum paddle, is depressed, C33 charges up to the supply voltage and the R input (10) of U5-A is driven low. This action forces the $\overline{Q}$ output (12) of U5-A low, which turns on Q8. When the POWER switch S3 is released, U5-A's $\overline{Q}$ output (12) will stay low until C33 has discharged to approximately 65% of the supply voltage. At this time the reset gate threshold will be reached and the $\overline{Q}$ output (12) will be forced high again.

3-37. On/Off Circuitry. (Continued)

On the positive transition of U5-A's $\overline{Q}$ output (12), U5-B will be clocked to the opposite of its previous state. Therefore, if the Q output (1) of U5-B was previously low and transistor Q11 was off, it will be clocked high and transistor Q11 will turn on, energizing the on/off relay. The time constant of R46 and C33 is set so that the minimum time to reach the reset threshold of U5-A is adequate for Q8 to charge C1 and C2 to full supply voltage under minimum beta conditions. The purpose for this delay is to prevent the on/off relay from having to switch high capacitor charging currents, thereby degrading its contacts. The purpose of C32 and R63 is to put U5-B in its reset condition when the Battery/Pak is connected to the circuit.

L1 and C2 filter the 12Vdc battery voltage and supply a +12V source voltage to the circuitry. CR19 protects the 12V source from over-voltage transients.

3-38. Energy Select Circuitry. The Energy Select Circuitry senses the selected energy level and determines if the charge storage capacitor has the correct amount of voltage to deliver that energy. The major components of this circuitry include three stages of U6(A-C), transistor Q10 and the ENERGY JOULES select switch S4.

The function of the network consisting of R47, R48, R49, R50, and CR22 is to set up a stable reference voltage on the non-inverting input (12) of energy select amplifier U6-A. A 6.2V reference voltage is also applied to U6-D in the battery test circuitry. CR22 is a reference diode and R48 is a compensation trim pot for calibration of energy delivered.

The output of U6-A is dependent on the resistors switched in by the ENERGY JOULES switch S4. Ready comparator U6-B will have a high output until the charge capacitor is charged up to a voltage which is proportionately higher than the output voltage of U6-A. At this point U6-B's output swings low, signifying to the charge control logic that the charge storage capacitor is charged to the correct energy level and to stop charging. At this point Q10 is turned on via U3-A-6 pulling the non-inverting input of U6-B-5 down by the divider network consisting of R57 and R58. This provides the hysteresis which allows the charge storage capacitor to bleed down approximately 10% in energy before the U6-B comparator signals the charge control to start charging again. This occurs several times after each charge initiation.

U6-C acts as an energy select disarm. Its function is to cause the charge control logic at U3-B-2 to direct the dump charge relay to dump. This would occur when changing the setting of the ENERGY JOULES switch S4 after the Defibrillator has been charged.

3-39. Charge Control Logic Circuitry. The Charge Control Logic Circuitry controls the charge and the transfer of the energy stored on the charge capacitor. The major components of this circuitry include data flip-flops U4-A and U4-B, four stages of NOR gates U2-A through D, four stages of NAND gates U3-A through D, transistors Q4, Q5, Q7 and the transfer and dump/charge relays.

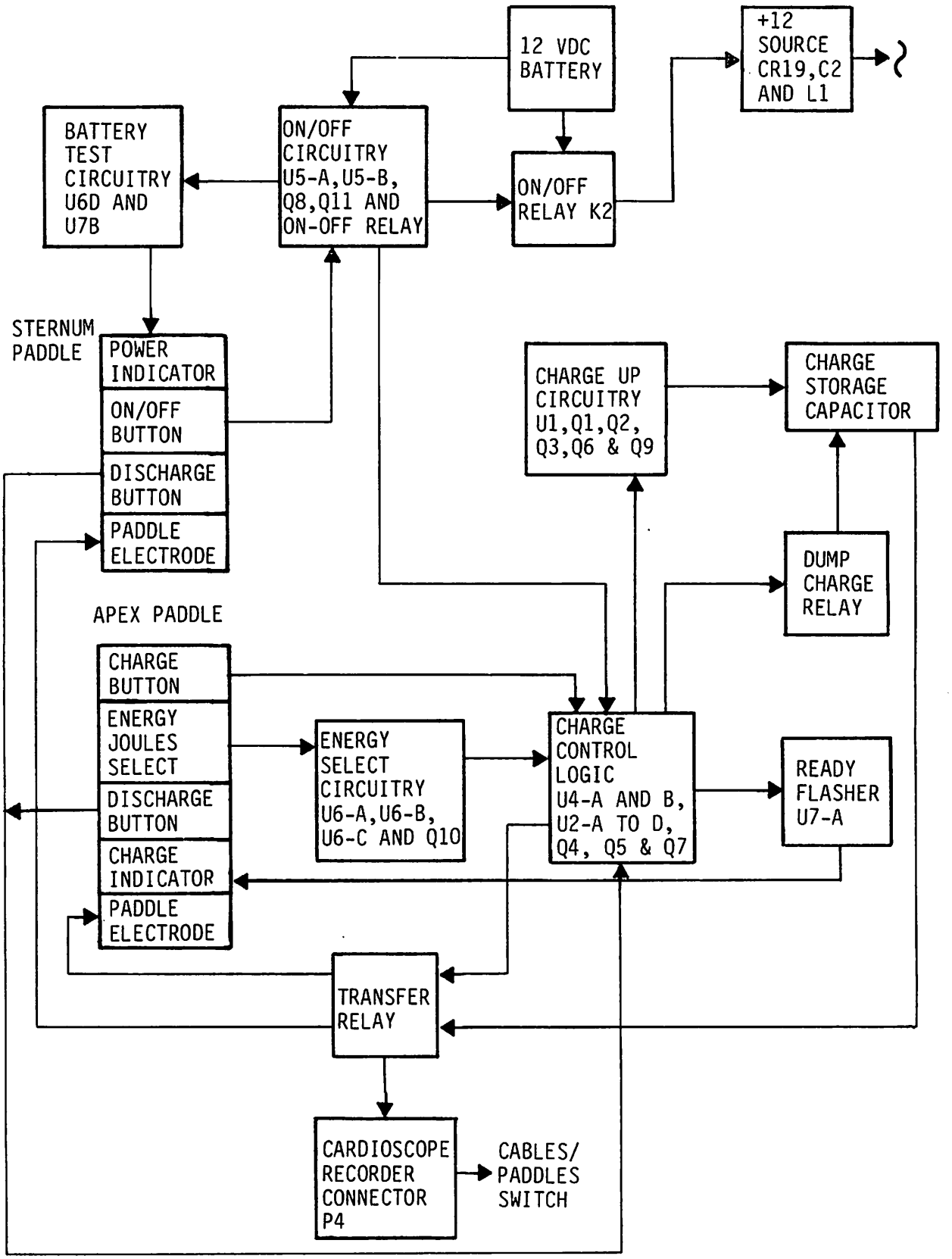


FIGURE 3-11. DC DEFIBRILLATOR BLOCK DIAGRAM

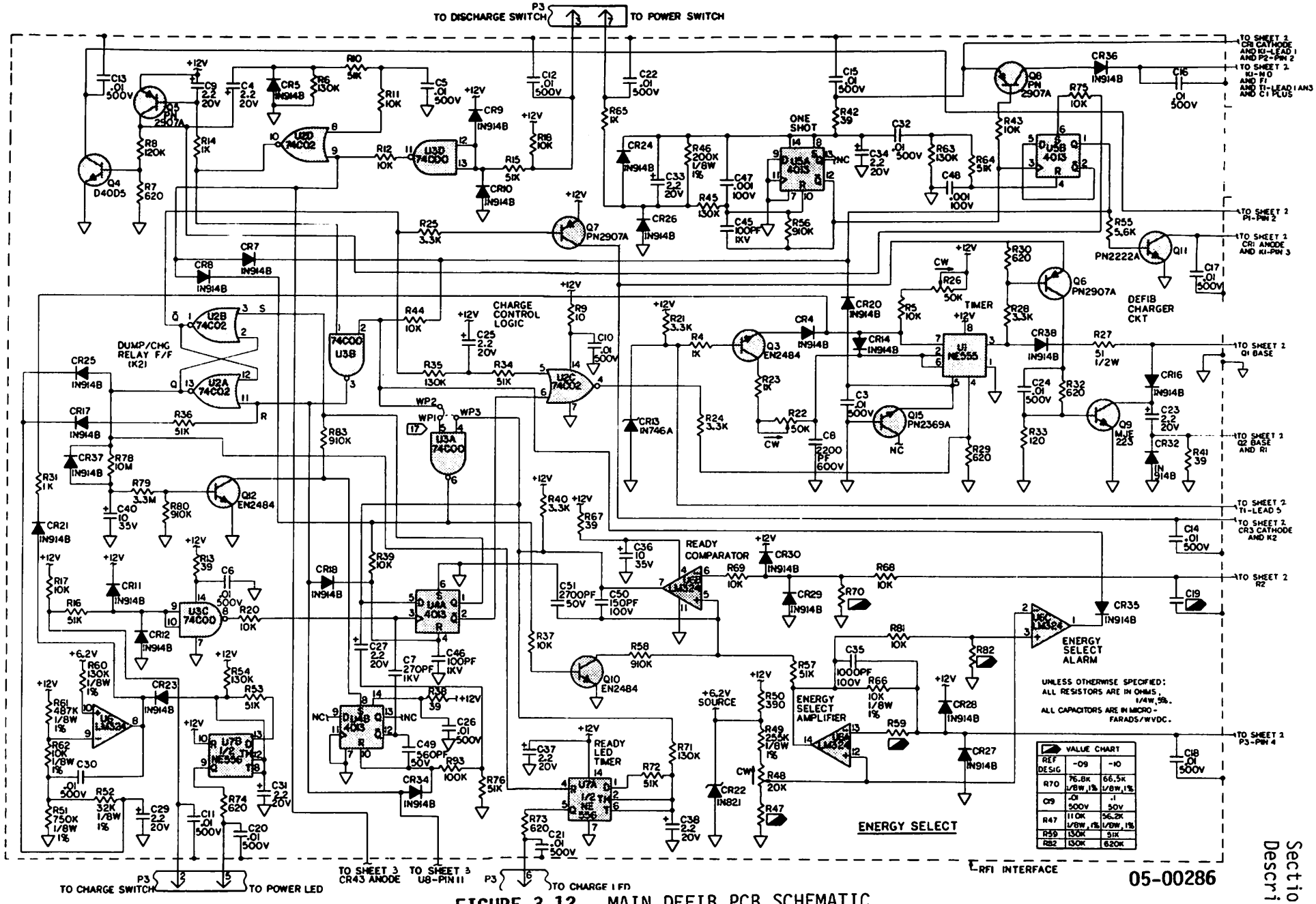


FIGURE 3-12. MAIN DEFIB PCB SCHEMATIC
(SHEET 1 OF 3)

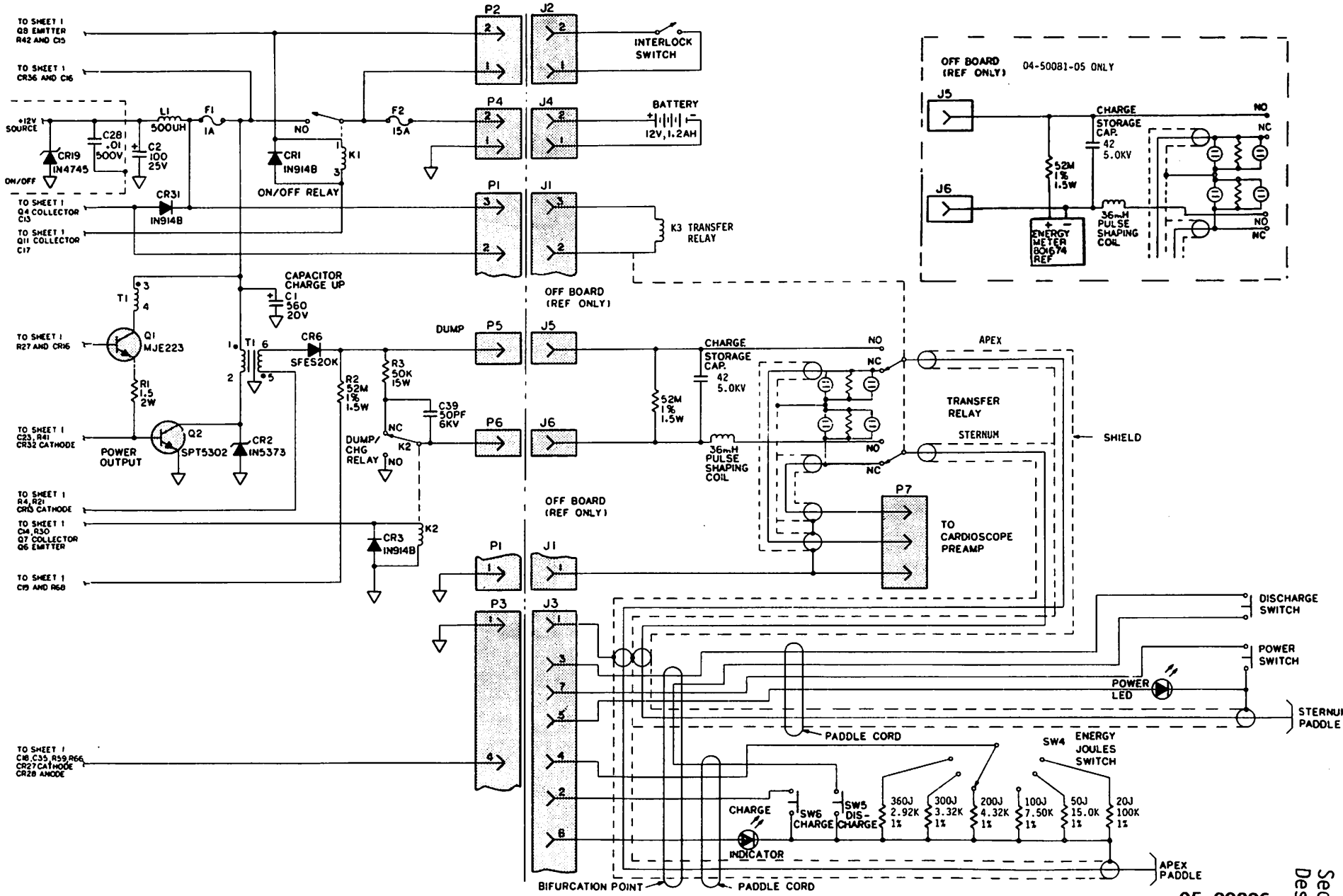


FIGURE 3-12. MAIN DEFIB PCB SCHEMATIC
(SHEET 2 OF 3)

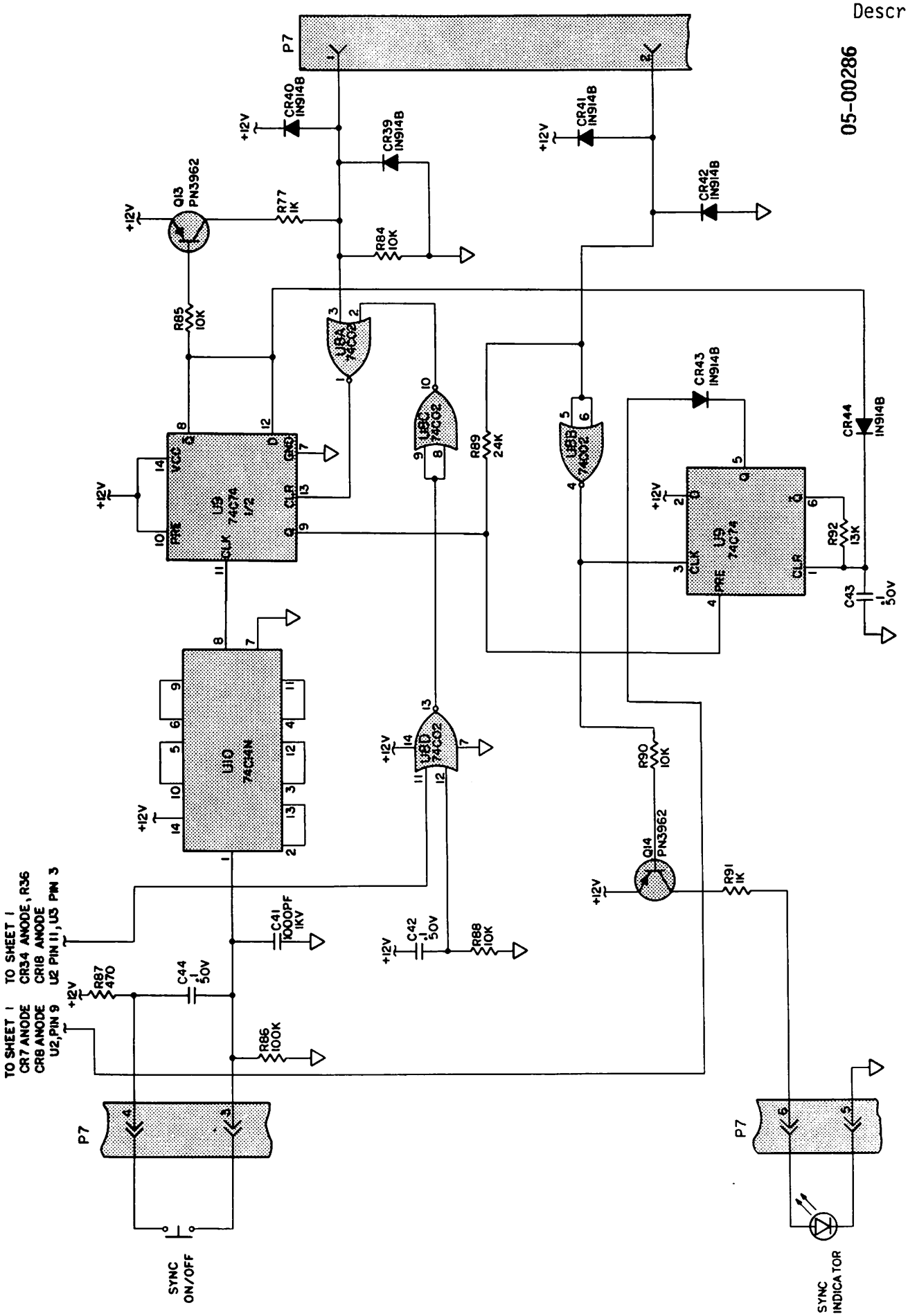


FIGURE 3-12. MAIN DEFIB PCB SCHEMATIC
(SHEET 3 OF 3)

3-39. Charge Control Logic Circuitry. (Continued)

When the circuitry is first turned on, the Q output (1) of U5-B in the on-off Circuitry sets up the charge control logic in its initial conditions (refer to paragraph 3-36). This is done by causing a reset to the R input (4) to U4-A and to the flip-flop comprised of U2-A and B through NAND gates U3-A and B respectively.

After the on/off relay is energized, charge can be initiated by depressing the CHARGE button S6. Depressing the CHARGE button S6 causes U3-C's output (8) to swing high, clocking the CK input (3) of U4-A. With a high from the ready comparator U6-B on the D input (5) of U4-A and U4-A Q output (1) goes high. This causing U2-A and B flip-flops to be set, triggering Q7 to turn on and energize the dump charge relay K2. U4-A's $\overline{Q}$ output (2) will also swing low, which after a delay time determined by R35 and C25, causes U2-C's output to swing high. When U2-C's output (4) swings high it actuates the capacitor charge-up circuitry at (4) of U1. This delay is provided so that the dump/charge relay K2 will have time to activate, completing the charge path, before the capacitor charge up circuitry is actuated, thus preventing arcing at K2.

The charge circuit will be held on until the ready comparator U6-B's output (7) swings low, in turn causing a reset to U4-A through U3-A. Transfer is inhibited until ready by diode CR8 which holds the one input of U2-D low until the output of U3-A swings high. Once the output of U3-A swing high, transfer can be initiated by depressing the Discharge buttons S2 and S5, which causes U3-D's output to swing high. This causes U2-D's output to swing low, turning on Q4 and Q5. The capacitor feedback (C4) from the collector of Q5 to the input of U2-D pin 10 causes the transfer relay to stay activated until the capacitor C4 charges up to approximately one-half supply. The charge rate of this capacitor (C4) then determines the transfer relay minimum on time.

The function of U4-B is to cause an automatic recharge once after each charge initiation. Each time a charge is initiated by depressing the charge button, U4-B-8 is set via the positive swing of U3-C. Once the charge storage capacitor is completely charged and bleeds down to a not ready condition, the ready comparator's U6-B output swings high, causing a reset to U4-B, in turn causing the $\overline{Q}$ output (12) to swing high. This high is coupled via C7 to the CK input of U4-A-3. This clocks a high from the D input (5) of U4-A to the Q output (1), causing a recharge.

3-40. Ready Flasher Circuitry. The Ready Flasher Circuitry indicates the state of charge on the charge storage capacitor. The circuit essentially consists of oscillator U7-A and the CHARGE Indicator.

Once charge is initiated, U2-A's output swings high, enabling U4-A to oscillate whenever the ready comparator's U6-B output is high. The oscillator frequency is determined by R71, R72 and C38. Since the ready comparator U6-B is high whenever the charge storage capacitor is not completely charged, U7-A will oscillate. Its output will be a ready high whenever the ready comparator U6-B output is low. This yields a flashing charge indicator while the unit is charging or is not ready, and is on solid whenever the charge storage capacitor is fully charged and ready.

3-41. Capacitor Charge Up Circuitry. The Capacitor Charge Up Circuitry charges the charge storage capacitor. The major components of this circuitry include high speed timer U1, transistors Q1, Q2, Q3, Q6, Q9 and transformer T1.

The basic principle of the capacitor charge up circuitry consists of ramping up a current in the primary of transformer T1 to the point where the transformer is very nearly saturated while the transformer secondary essentially opened circuited (CR6 reverse biased). The primary current is then terminated and the energy stored in the core is allowed to dump into the charge storage capacitor via the secondary winding, CR6 and the dump/charge relay K2.

High speed timer U1, R26 (pot), R5 and C8 are used to determine the on time of the primary current and therefore energy stored in the core during each cycle.

Q2 is the main output driver for the Capacitor Charge Up Circuitry. The voltage on the capacitor C23, via emitter follower Q1 and R1, determines the base drive current for Q2. The charge rate of capacitor C23 is set to ramp up the base current for Q2 in conjunction with Q2's collector current ramp. The network of Q6, Q9, R28, R30, R32, R33, C23 and C24 provide a base turnoff current spike to Q2.

The primary current's off time is determined by the network consisting of Q3, R4, R21, CR13, R22 (pot) and R23. The timer output is held low until all the energy in the core of the transformer T1 is discharged into the secondary circuit. A delay time determined by C8, R23 and R22 (pot) is applied to the timer U1 to keep its output from going high again so that Q2 does not switch on into the high collector voltages seen during its off time. A 68V zener diode CR2 functions to protect Q2 from the high voltages of leakage inductance spikes and from inadvertent damage from operating the circuit with the secondary unloaded during test.

3-42. Battery Test Circuitry. The Battery Test Circuitry monitors the battery charge state during quiescent conditions and during the charging of the charge storage capacitor. The circuitry protects the battery against cell reversal when the battery is depleted. The major components of this circuitry include comparator U6-D, timer U7-B and the POWER indicator (low battery indicator).

Comparator U6-D's output will be low if the battery voltage is above a predetermined level as defined by the difference between the reference voltage from CR22 (6.2V) and the ratio of R51 + R62/R61 voltage divider. When U6-D's output is low, C31 is held at 0.5V above ground maintaining timer U7-B's output high.

When the battery voltage falls to approximately 10.0V with the defibrillator on as a load (charge indicator off), comparator U6-D's output goes high, allowing U7-B to oscillate. This drives the POWER indicator causing it to flash, indicating low battery. This test only operates while the CHARGE indicator is off.

3-42. Battery Test Circuitry. (Continued)

To protect the battery from cell reversal during charging when the battery is depleted, a minimum voltage limit of approximately 8.5V during charging of the charge capacitor is placed on the battery. This is accomplished by reducing the curent drawn by the capacitor charge up circuitry as the battery voltage approaches 8.5V. During charge U2-A's output is high, placing R52 in parallel with R61 and R62 causing U6-D to compare at 8.5V (versus 10.0V as mentioned before). When U6-D's output goes high a parallel charge path to R26 and R5 is created with CR21 and R31. This decreases the charge time of C8 and therefore decreases the on time of timer U1, causing the capacitor charge up current to decrease. This decrease also causes an increase in charge time.

3-43. Synchronized Cardioversion. The synchronizer can only be used if the ECG Monitor/Recorder and Defibrillator are connected. Figure 3-13 provides the Synchronizer Circuitry Schematic.

When power is applied, a positive pulse is coupled to pin 12 of U8, through C42, causing pin 13 of U8 to go low. This low level pulse is inverted once at pin 10 of U8, and again at pin 1 of U8, causing a low level pulse at pin 13 of U9. This is the clear input which causes Q, pin 9 of U9, to go to a low level assuring that the defibrillator turns on the non-syncronized mode.

When the SYNC pushbutton is pushed on a Defibrillator which is either not connected to a ECG Monitor/Recorder or is connected to a ECG Monitor/Recorder lacking a sync circuitry, a positive pulse is applied to pin 11 of U9. Since pin 8 is connected to pin 12 of U9, the output of pin 8, of U9, toggles low momentarily. This causes Q13 to turn on, and since point P7-1 is not held low by the LED in U2, a positive level is applied to pin 3 of U8 causing pin 1 of U8 to go low and reset U9 to the non-synchronized mode.

Whenever U9 is in the non-synchronized mode, pin 9 of U9 is always low. This holds pin 4 of U9 low. Pin 8 of U9 holds pin 1 of U9 high through diode CR44. These are the preset and clear inputs of U9 and when addressed in the above manner, pin 5 of U9 is high, allowing normal non-synchronized defibrillator operation.

When the SYNC pushbutton switch is pushed on, with the Defibrillator connected to the ECG Monitor/Recorder unit with the Synchronizer, pin 8 of U9 again toggles low turning on Q13. However, the LED in U2 is not connected to P7-1 turning the LED on.

Since the voltage of the LED is less than the high level threshold voltage of U8, pin 3, pin 1 of U8 remains high. Pin 9 of U9 is now high and due to the interconnection of R92 and C43, pin 5 of U9 goes low inhibiting transfer. R89 also raises pins 5 and 6 of U8 to a high level which causes pin 4 of U8 to go low. This condition turns on Q14 and illuminates the SYNC indicator through current limiting resistor R91.

Turning the LED on in U2 causes the transistor in U2 to turn on and applies a high level to pin 2 and 5 of U3. A positive pulse of

3-43. Synchronized Cardioversion. (Continued)

approximately 200ms duration is applied to J1-12 each time a patient generated R-wave is detected. The amplitude is divided down by R6 and R7, and then applied to pin 4 of U3. This causes pin 6 of U3 to go low for 200ms, whenever an R-wave is detected, and turns on Q1 through current limiting resistor R2, and in turn, turns on the LED in U1 through current limiting resistor R1. This causes the transistor in U1 to turn on and pull pins 5 and 6 of U8 low causing pin 4 of U8 and pin 3 of U9 to go high. Since D, pin 2 of U9 is at a high level, Q, pin 5 of U9 goes high momentarily allowing transfer when the discharge pushbuttons are pressed, then resets to a low level in approximately 1ms due to the RC network of R92 and C43. This prevents firing the Defibrillator too far after the R-wave detection. The high level pulse at pin 4 of U8 also turns off Q14 and the sync indicator LED for 200ms with each R-wave detected. When the Defibrillator is fired, a high level pulse is applied to pin 11 of U8 causing the Defibrillator to return to the non-synchronized mode. If another synchronized discharge is desired, the SYNC pushbutton switch must be pushed again.

A feature of the synchronizer circuit is to provide a sync marker on the CRT display. This sync marker tells the operator where on the R-wave the defibrillating pulse will be delivered. A 200ms R-wave detection pulse is taken from the output of the systole sound circuit and is differentiated and divided down by C1, R5 and R4, then applied to pin 1 of U3. In the synchronized mode, pin 2 of U3 is high and a low level pulse appears at pins 3 and pin 13 of U3 each time an R-wave is detected. This sets latch gates of U3 so that pins 10 and 11 of U3 and pin 6 of U4 are high. U4 is a 512 bit shift register and runs essentially in parallel with the no-fade shift registers. Thus, whenever an R-wave is detected, a high level is written into U4 by a high level write pulse to pin 5 of U4. The latched gates of U3 are then reset by a low level pulse to pin 9 of U3. The clock pulses are applied to pins 1 and 7 of U4. 512 clock pulses after the high level pulse is written in and it appears at pin 2 of U4 and turns on Q2, causing a 12V negative going pulse to be coupled through C28 to the cathode of the CRT. This 200ms pulse to the cathode increases the brightness and changes the focus of the CRT trace. The pulse appears as a short thick section on the trailing edge of the R-wave.

This sync marker cannot occur if the ECG Monitor/Recorder unit is not connected to a Defibrillator unit placed in the sync mode. Transistor in U2 would be off and R3 would hold pin 2 of U3 low and inhibit U3's output, pin 3 from going low and setting latch gates of U3. Similarly, U1 is inactive as pin 5 of U3 is also held low by R3, disabling pin 6 of U3.

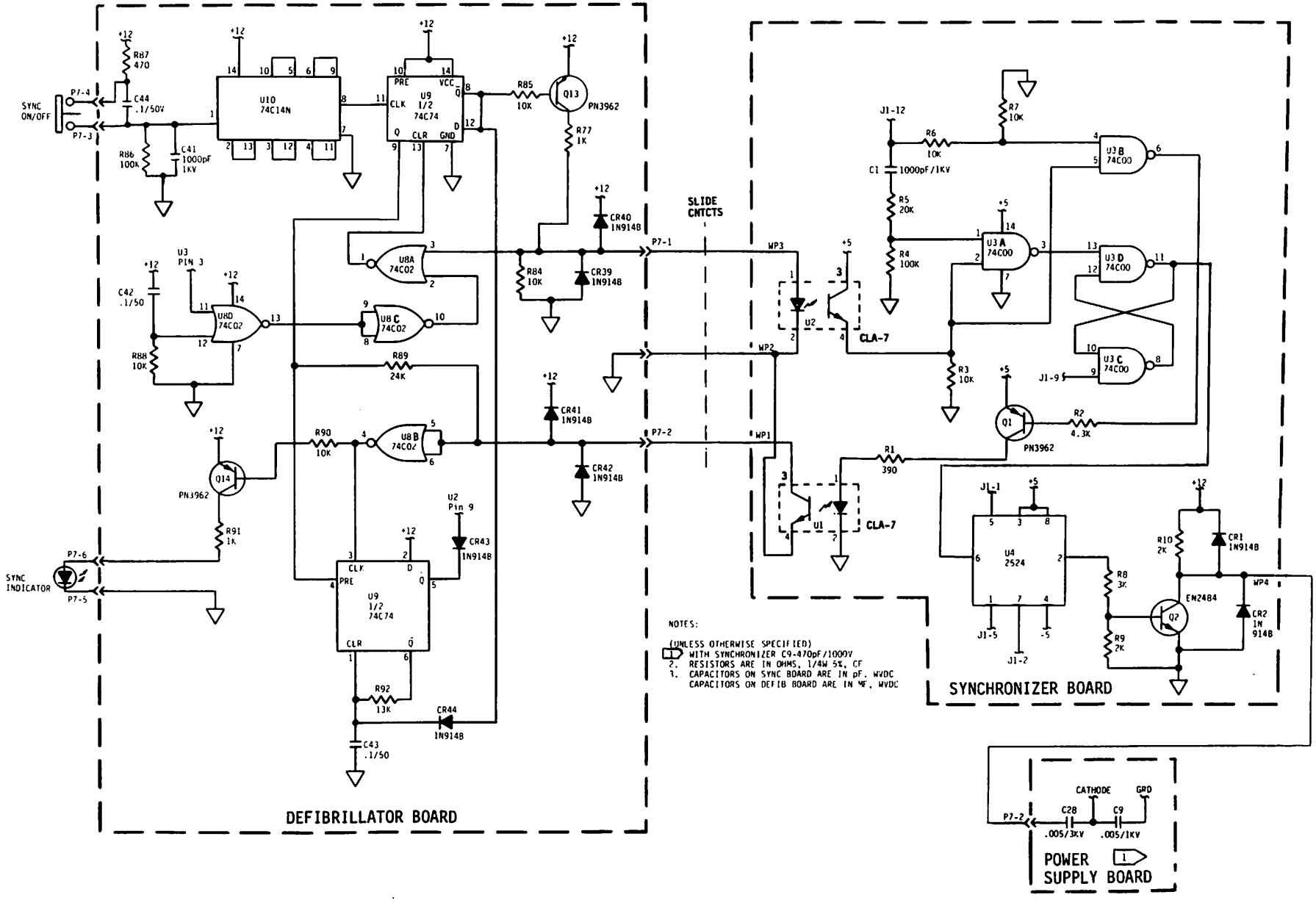


FIGURE 3-13. SYNCRONIZER CIRCUIT

3-44. ACCESSORY EQUIPMENT

The following paragraphs provide the circuit description for the accessory equipment available for the LIFEPAK 5 ECG Monitor/Recorder and DC Defibrillator units.

3-45. Battery Charger Circuitry. The circuit description is presented by individual circuit function. Figure 3-14 provides a Battery Charger Circuitry Schematic drawing. The function of the charger is to simultaneously charge two one ampere/hour Battery/Pak at a 300mA rate.

3-46. AC Supply Circuitry. The battery charger is capable of operating with either 115VAC 50-60Hz; 220VAC 50-60Hz; or 11-15Vdc. TB1 provides the facility to manually switch the primary terminals of transformer T1 from 115VAC to 230VAC input. Full wave rectification of the input voltage is accomplished using CR7 through CR10.

3-47. DC to DC Converter Circuitry. The dc to dc circuitry converts a 12Vdc input to a voltage high enough to operate two separate battery charger circuits. U1-A is one-half of a dual timer which operates as a free running oscillator at a frequency of approximately 4KHz. U1-B functions as an inverter/buffer which is driven by U1-A. Q1 through Q4 are driven by U1-A and B and operate in a push-pull fashion to charge doubler capacitors C8 and C9 and discharge them into the filter capacitor C11 in the voltage regulator circuitry. When U1-B's output is high, transistor Q4 is on and C9 charges up through CR5. When U1-B's output goes low, transistor Q3 turns on and saturates, and the charge stored on capacitor C9 is transferred to C11 through CR6. Diode CR1 and the 2A fuse function to protect the circuitry should the input voltage be inadvertently connected in the wrong polarity.

3-48. Voltage Regulator Circuitry. C11 provides capacitor filtering for the outputs of the bridge rectifier or the dc to dc converter. Transistor Q5 functions as an emitter follower voltage regulator protecting the integrated circuits U2, 8 and 10 from unloaded high line voltages of AC operation. Zener diode CR11 limits the supply voltages on these integrated circuits to 28V or less. U2 provides a 15V reference and supply voltage for the various CMOS integrated circuits.

NOTE: In the following paragraphs of 3-49, 3-50 and 3-51, reference designators outside of parenthesis correspond to the circuitry associated with the right hand battery position (as viewed from the front of the Charger) and those inside parenthesis correspond with the left hand battery position.

3-49. Battery Charging Current Source Circuitry. Two identical circuits regulate charging current to the two batteries under charge. The resistor ladder comprised of R27, R29, R30, and R31 (R57, 58, 59, and 60) divides the 15V reference to provide certain reference voltages at the output of voltage follower U8B (U10B). This reference voltage will take on two values, depending upon whether Q11 (Q17) is off or saturated.

3-49. Battery Charging Current Source Circuitry. (Continued)

When Q11 (Q17) is on, R29 (R58) is effectively shorted, providing approximately 3.3V, adjusted by R31 (R60), at the output of U8B (U10B). When Q11 (Q17) is off, this reference voltage drops to approximately 0.77V, which corresponds to the charge current value for "sustaining charge" after the charging timer cycle has been completed.

The reference voltage at the output of U8B (U10B) is applied to the precision sense amplifier comprised of U8A, R21, R22, R25, R23, R26, Q9 and Q10 (U10A, R51, R52, R54, R56, Q15, Q16). This amplifier supplies a charging current through Q9 (Q15) such that the voltage across the sense resistor R23 (R52) is 15/110=0.136 times the reference voltage. This corresponds to a charge current of 300mA for a reference voltage of 3.3V and 70mA for 0.77V. While the battery is being charged at a 300mA rate, if the terminal voltage begins to exceed the 15V reference, the output of comparator U8C (U10C) takes over control of the base of Q11 (Q17), acting through CR14 (CR21). The comparator thus tends to increase the effective shunt resistance of Q11 (Q17) so as to reduce the charging current to the point where the battery terminal voltage does not increase significantly beyond the 15V reference.

CR23 (CR22) prevents a charged battery from discharging into the charger circuitry if the charger is disconnected from the power source. Q6 (Q7) provides an "on-off" switch for the current source, controlled by the circuitry described in paragraph 3-50.

3-50. Charge Indicator Control Circuitry. Two identical circuits electronically sense when a battery has been placed in the battery charger. These circuits limit the risk current present at the charger terminals when no battery is present and control the CHARGE indicators. When no battery is present in the right hand (left hand) position, the non-inverting input of U8D (U10D) is held high (around 18-28V) through R28 (R61). The inverting input of U8D (U10D) is referenced from a diode drop (approximately 0.6V) above the 15V reference. Thus the output of U8D (U10D) is high, ensuring that the "D" flip-flop of U6A (U6B) is reset, i.e., that the Q output of U6A (U6B) is low. The high output of U8D (U10D) also causes the output of U5B (U5D) to be low, which, in turn, turns on Q14 (Q20), thus charging up C18 (C24) and thereby causing the output of U5A (U5C) to be low. The low output of U5A (U5C) causes Q13 (Q19) to be turned off, which, in turn, shuts down the current source by turning off switch Q6 (Q7). Therefore, when no battery is installed, only a trickle of leakage current (less than 100μA) can flow from the (+) charger terminal.

When a battery is inserted into the right hand (left hand) position, the voltage at the non-inverting input of U8D (U10D) will be pulled below 15V, (since the terminal voltage of an undamaged battery cannot exceed 15V except under charge) causing the output of U8D(U10D) to go low. When this occurs, and after a delay of approximately 5ms due to the time constant of R47 (R66) and C20 (C26), the output of U5B (U5D) goes high, because the Q output of U6A (U7B) had previously been reset low. Q14 (Q20) is thereby turned off allowing C18 (C24) to discharge through R41 (R78). After

3-50. Charge Indicator Control Circuitry. (Continued)

approximately 2.6 seconds, the output of U5A (U5C) goes high turning on Q13 (Q19), which, in turn, lights the CHARGING indicator and turns on switch Q6, (Q7), through R20 (R50) allowing the current source to charge the battery at 300mA.

If, instead of a battery, a relatively low resistive load (225Ω - 500KΩ) is placed across the battery terminals, the battery charger will turn on as described above. However, the moment the charger turns on, voltage at the positive battery terminal will rise well above 15.6V. This has an immediate effect of causing the output of U8D (U10D) to go high and clocking U6A (U6B).

Since the D output of U6A (U6B) will be high under these conditions, the Q output will immediately go high. The resettng of U6A (U6B), when the output of U8D (U10D) goes high, occurs only after a delay of approximately 5ms, set by R45 (R64) and C19 (C25). Thus, the Q output of U6A (U6B) will be high for a period of time. However, during this period, the battery charger is turned off in the manner described above since the output of U5B (U5D) has gone low. With the resistive load still connected across the battery charger terminals, and with the charging current off, the voltage at the positive charger terminal will drop close to 0V. This will cause the output of U8D (U10D) to again go low, which occurs before U6A (U6B) has been reset. This is a stable condition, with the charger latched off until the resistive load is removed. Therefore, with the exception of a very brief (less than 5ms) spike, a resistive load greater than 225Ω will not draw more than a trickle (less than 100μA) of current from the charger terminals. A very high resistive (greater than 500KΩ) will not cause the charger to be turned on at all if placed across the battery terminals.

The one-way RC delay caused by R43 (R72), CR25 (CR26) and C21 (C27) prevents the D input of U6A (U6B) from going high until a battery is well established in the charger, thus preventing the charger from latching off if contacts between the charger and battery terminals are intermittent during insertion.

3-51. Charger Timer Circuitry. Two identical circuits count a common clock which times the duration of charge for each battery, and controls the charging rate and the TIME indicators. U7 (U9) is a 12 stage binary ripple counter which counts the clock pulses generated by the Clock Circuitry (see paragraph 3-52). From a state of being reset (all outputs low) to the point where the MSB output (pin 1) goes high, U7 (U9) will count 2^{11}=2048 clock pulses. When the charger current source is turned off, the output of U4B (U4D) will go high, since the input at pin 9 (pin 6) will be low.

With the battery charger current source turned off, the output of U5B (U5D) will be low. The output of U4A (U4C) will then go high thus resetting U7 (U9). When a Battery/Pak is placed in the charger, the output of U5B (U5D) will go high causing the output of U4A (U4C) to go low, removing the reset from U7 (U9) and allowing it to count. Due to the RC

3-51. Charger Timer Circuitry. (Continued)

delay of R43 (R72) and C21 (C27), about 0.2 seconds later the input at pin 9 (pin 6) of U4B (U4D) will go high. However, since the input at pin 8 (pin 5) is low, the output of U4B (U4D) will remain in high. This situation will persist until either the Battery/Pak is removed, (resetting the timer as noted above), or U7 (U9) counts 2048 clock pulses. At this time, pin 1 of U7 (U9) will go high, causing the output of U4B (U4D) to go low.

This in turn causes the output of U4A (U4C) to go high, turning on Q12 (Q18) and thereby illuminating the TIME indicator, also turning off Q11 (Q17), thus reducing charge current to the sustaining rate (approximately 70mA). This condition is stable and will remain unchanged until the Battery/Pak under charge is removed from the charger, resetting the timer as noted above.

3-52. Clock Circuitry. A common clock for charger timing is provided by U3 operating as an astable multivibrator at a frequency of 0.128Hz ±10% which is set by R15, R17, C15. The clock duty cycle, which is approximately 33%, is not critical to the operation of the timer circuit. The clock waveform may be observed at TP-1. This clock frequency yields a 2048 pulse timer cycle of 4 hours, 27 minutes ±10%.

3-53. Power-Up Reset Circuitry. When the battery charger is connected to an AC or 12Vdc source, the rapidly rising voltage on C13, (the filter capacitor for the 15V reference), acting through the RC delay of R12 and C14, causes Q8 to be turned on and in saturation for a period of approximately 0.25 seconds. Through CR16 and CR20, the outputs of U8D and (U10D) are thereby overridden by a high voltage, duplicating condition of an absence of batteries from both left and right hand positions. This effectively resets all functions of both systems so that if the charger is connected to the power source while one or two batteries are inserted, proper operation is ensured.

800413

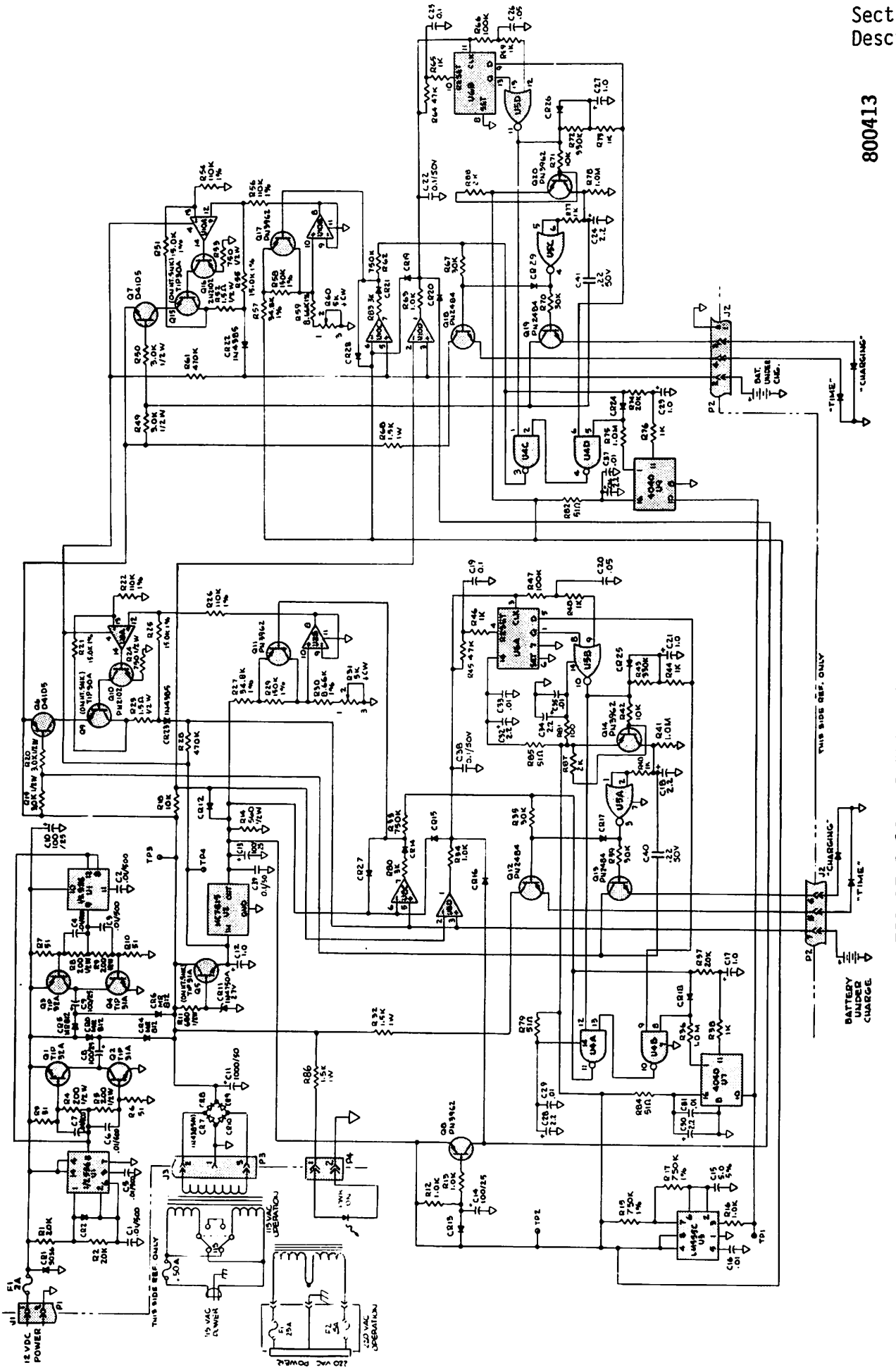


FIGURE 3-14. BATTERY CHARGER PCB SCHEMATIC

SECTION 4
MAINTENANCE

4-1. INTRODUCTION

This section provides maintenance procedures for LIFEPAK 5 ECG Monitor/Recorders, DC Defibrillator Units, and accessories. The section is divided into four parts, the first provides general information about the units and subsequent parts of the section are: Inspection and Repair, Major Component Removal and Installation, and Testing and Troubleshooting.

4-2. GENERAL

The following paragraphs provide general information applicable to the ECG Monitor/Recorder and DC Defibrillator units and accessory equipment. The topics include warranty, inspection and repair, and cleaning information.

4-3. Warranty. LIFEPAK 5 is warranted against all defects in parts and workmanship for a period of 1 year from the date of delivery; patient cables and stylus - 90 days. Physio-Control will repair or replace any products which prove to be defective during the warranty period, provided proper use and maintenance procedures are followed as prescribed in the operating and service manual.

All defective products or components must be returned to Physio-Control, or its authorized service center, with a detailed explanation of the failure. Transportation charges must be prepaid.

Service performed by other than Physio-Control or its authorized agents may, at the discretion of Physio-Control, be cause to void this warranty.

No other party is authorized to make any other warranty or to assume any liability for Physio-Control products. No other warranty, either implied or in writing, will be recognized.

4-4. Inspection. Inspect the equipment for obvious symptoms of malfunction, such as odors from overheated components or mechanical failures. Look for bent connector pins, damaged or defective traces on PCBs. Inspect for breaks, scratches, nicks or pinholes. Examine for lifted conductors on PCBs, scratches or burns. Examine for warped covers, cracked panel fronts, etc.

4-5. Repair.

A. General.

1. Instructions contained in this section provide the information necessary to return the LIFEPAK 5 unit and its subassemblies to serviceable condition.

4-5. Repair. (Continued)

A. General. (Continued)

2. Conduct the necessary level of disassembly and inspection to identify all areas requiring repair.

3. Before removing a PCB for repair or replacement, label each lead or draw a skatch showing the location of cables and wires.

B. List of Materials.

The following is a list of recommended materials, tools and chemicals to have available when conducting repairs.

1. Nylon rod with one end flattened.

2. Crocus cloth, available from commercial sources.

3. Solder, activated rosin-core, tin-lead wire Sn 60 or Sn 63 Type R or RMA per Federal Specification QQ-S-571d.

4. Sleeving, silicone-treated fibreglass, Class HA1 or HC1 per MIL-I-3190 or equivalent.

5. 5-Minute Epoxy - Manufactured by Devcon Corporation, 59 Endicott Street, Danvers, Massachusetts, 01923.

6. Solder vacuum Part Number LTS13 - Manufactured by EDSYN Inc., 15954 Arminta Street, Van Nuys, California, 91406.

7. HumiSeal, Type 1B31, (protective coating) - Manufacutred by HumiSeal Division of Columbia Technical Corporation, Woodside, New York 11377.

8. Isopropyl alcohol, 99% pure, available from commercial sources.

9. Perchloroethylene.

10. Masking Tape.

C. Repair.

NOTE: Repair procedures contained here are recommended only as an alternative to complete assembly replacement.

1. Do not attempt to straighten bent connector pins or chassis frame members unless the bending or warpage is slight. Parts damaged beyond this level should be replaced.

2. PCB-installed components are normally nonrepairable and must be replaced when found faulty.

4-5. Repair. (Continued)

D. PCB Component Replacement.

1. Replace all electronic components not meeting the requirements outlined in TESTING and TROUBLESHOOTING.

2. Replace electrical wire as required with wire of same length, color and gage as that being replaced.

3. Before attempting to remove components, remove conformal coating from both sides of the PCB assembly by heating with a soldering iron and pushing the softened coating away with a nylon rod.

4. Clip leads near the body of the faulty component to be removed.

5. Grasp the component with pliers and carefully break it free of residual conformal coating.

6. Use a low voltage soldering iron and pliers to remove component leads from printed circuit board. Take care to avoid lifting solder pads.

7. Heat solder pads with soldering iron until conformal coating* begins to curl and bubble; then remove coating from area with cloth soaked in perchloroethylene.

WARNING

PERCHLOROETHYLENE EMITS TOXIC FUMES. USE ONLY IN A WELL VENTILATED AREA.

8. Remove excess solder from solder pad by wicking or vacuuming.

CAUTION

WHEN INSTALLING COMPONENTS ON PRINTED CIRCUIT BOARD, REFER TO TRANSISTOR INDEXING, TAB POSITIONS, DIODE MARKINGS AND CAPACITOR POLARITIES ILLUSTRATED IN THE REFERENCED IPL FIGURE.

CAUTION

USE A HEAT SINK WHEN SOLDERING DIODES AND TRANSISTORS, AND USE A MINIMUM OF HEAT WHEN SOLDERING COMPONENTS TO PRINTED CIRCUIT BOARDS.

*International Models (TUV) only.

4-5. Repair. (Continued)

D. PCB Component Replacement. (Continued)

9. Bend new component leads to fit mounting solder pads in PCB and trim leads to desired length. Be sure component is oriented in the proper polarity position and install it on the board, then solder in place.

10. Clean residual flux from soldered areas with cloth dampened with isopropyl alcohol and dry with compressed air.

11. Test before applying protective coating.

12. Mask over PCB edge guide areas with masking tape.

13. Using brush or spray, apply HumiSeal protective coating over all reworked areas on both sides of PC board. Allow to dry at room temperature for one hour.

E. Repair of damaged or defective trace.

A damaged trace may be a complete break or scratches, nicks, or pinholes which reduce the cross-sectional area of the conductor beyond original design specifications. (See Figure 4-1.)

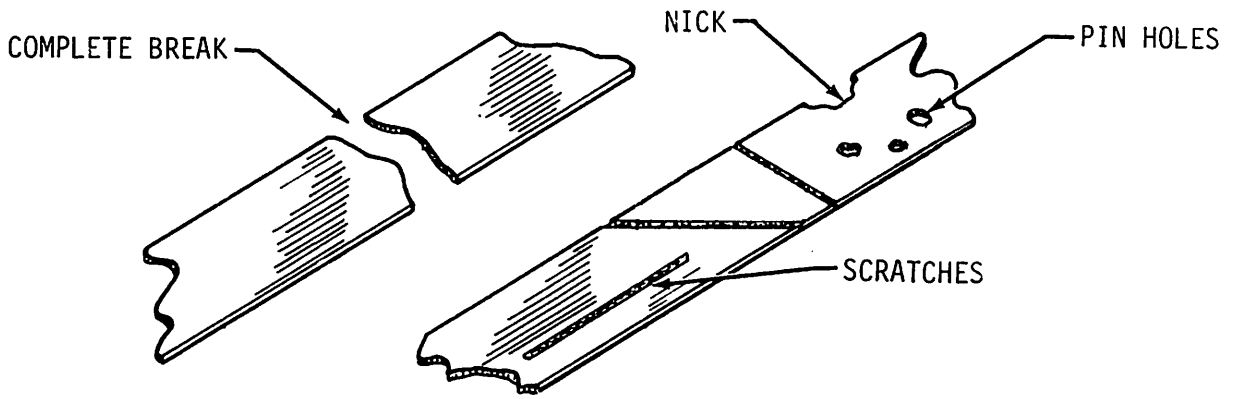


FIGURE 4-1. TYPICAL PRINTED WIRING DAMAGE

NOTE: Repair should be limited to two repairs per board. The damaged section of the conductor should not exceed five times the conductor width.

1. Remove conformal coating* only from areas to be repaired by heating with a soldering iron and pushing the softened coating away with a nylon rod.

*International Models (TUV) only.

4-5. Repair. (Continued)

E. Repair of damaged or defective trace. (Continued)

2. Clean both sides of break in conductor, at least 1/4 inch on each side, with a rubber eraser, then wipe clean with cloth dampened with isopropyl alcohol.

3. Cut a piece of 22 or 24 gage solid, tinned copper wire a minimum of 1/4 inch longer than the break. The wire may optionally be flattened by placing it between smooth metal plates and pressing with a bench vise.

4. Hold the wire on the centerline of the conductor, across the break, and solder in place. (See Figure 4-2.)

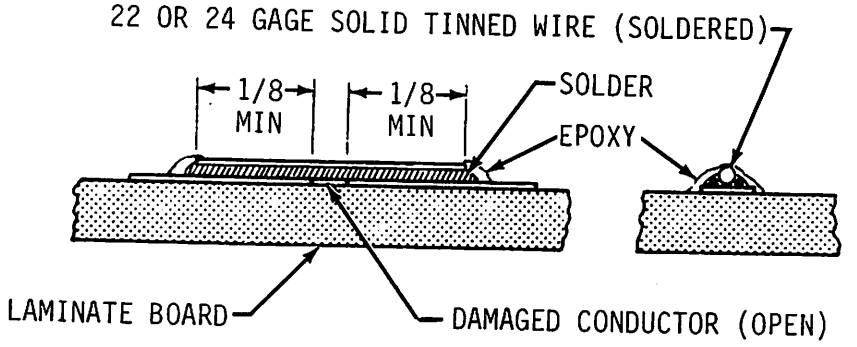


FIGURE 4-2. REPAIRING DAMAGED CONDUCTOR

5. Remove solder flux with cloth dampened with isopropyl alcohol and dry with compressed air.

6. Flow a small amount of 5-minute epoxy cement over the entire repair and allow to dry at room temperature for 15 minutes.

7. Using masking tape, mask over potentiometer adjusting screws.

8. Using a brush or spray, apply HumiSeal protective coating over all reworked areas. Allow to dry at room temperature for one hour.

F. Repairing lifted conductors.

A lifted conductor is present when a portion of the conductor is separated from the PC board surface, but is not broken. (See Figure 4-3.)

1. Clean conformal coating from area to be repaired by heating with a soldering iron and pushing softened coating away with a nylon rod.

4-5. Repair. (Continued)

F. Repairing lifted conductors. (Continued)

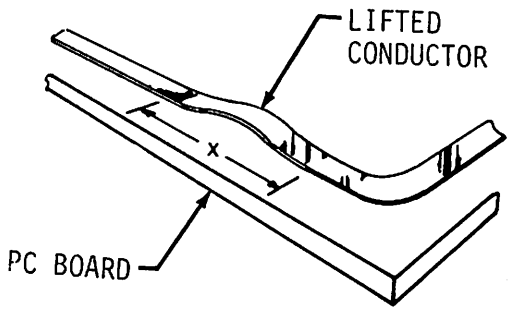


FIGURE 4-3. TYPICAL LIFTED CONDUCTOR

NOTE: The length of the lifted conductor which is repairable shall not exceed one half the length of the conductor path between two terminal areas or one half inch, whichever is smaller. See dimension X in Figure 4-3.

2. Further prepare area by cleaning with a cloth soaked with perchloroethylene.

> **WARNING**
>
> PERCHLOROETHYLENE EMITS TOXIC FUMES. USE ONLY IN A WELL VENTILATED AREA.

3. Dry with clean lint-free cloth.

4. Rinse clean area with isopropyl alcohol and dry with compressed air. Be sure that underside of lifted conductor is clean and remove any obstacles which prevent the lifted conductor from making total contact with the substrate surface.

5. Apply 5-minute epoxy to surface of lifted conductor and to a distance of at least 1/8 inch in all directions from the damaged area.

6. Brush or spray apply HumiSeal protective coating over entire repaired area and dry at room temperature for one hour.

4-5. Repair. (Continued)

G. Refinish.

1. Should the chassis exterior or covers be nicked, scratched or burred, the damaged areas can be repaired as follows:

a. Using crocus cloth, work burrs or nicks down to the level of the surrounding area.

b. Small bends such as turned up lips of covers can be straightened with pliers, then smoothed with crocus cloth.

c. Brush apply a coat of flat black model paint to the repaired surface.

2. Do not attempt to straighten severe bends, warped covers or cracked panel fronts. Should any damage of this nature be present, replace the part.

H. Repairing metal parts.

1. Restoration

a. Straighten bent chassis, remove dents, etc.

b. Remove scratches and burrs by sanding lightly.

c. Clean sanded areas with isopropyl alcohol.

d. Repaint as necessary.

2. Replacement

a. Replace all cross- or strip-threaded items.

b. If restoration does not return damaged parts to a serviceable condition, then the damaged parts should be replaced.

4-6. Cleaning. Use soap and water to clean external covers, patient cable, and CRT face. Do not use alcohol, solvents, or cleaning solutions. These cleaning agents may damage the surfaces of the instrument. For interior cleaning, use dry, compressed air. A dry, flexible paint brush can be used to dislodge thick dust.

Remove electrode paste from paddle surfaces after each use with disposable tissues. Use a soft cloth with soap and water to clean paddles. If paddle electrodes become pitted, use 3M Scotchbrite (abrasive pads) to smooth pits out. Toothpaste may be used to remove any discoloration. Do not use steel wool or autoclave, and do not immerse in fluids.

4-7. Major Component Removal And Installation. (ECG Monitor/Recorder)

The following procedures provide the sequence of removing and installing the major components of the ECG Monitor/Recorder. Recorder disassembly is presented as part of Recorder removal. Special instruction notes as required are provided as part of the removal or disassembly procedure. Remove or disassemble only to the point required. Figure 4-4 provides an exploded view of the ECG Monitor/Recorder to assist in the following procedure.

NOTE: Installation is, for the most part, the opposite of removal so only the removal procedures are provided.

4-8. Upper and Lower Case Separation.

CAUTION

The ECG Monitor/Recorder is coated inside with special conductive paint to shield the unit from RFI. Use caution so not to scratch or mar the coating, which would degrade the unit's RFI shielding capability.

A. Position unit so upper case (1) is down.

NOTE: When installing the 2 cases together, make sure gasket is positioned correctly.

B. Remove 13 screws (2) securing upper case (1) to lower case (3), remove 2 screws (4) securing PCB chassis (20) to lower case.

NOTE: If the O-rings on screws are damaged, replacement screws should be used for reassembly.

C. Separate the upper (1) and lower (3) cases and lay bottom cover aside. At this point Preamp PCB (21) and No-Fade PCB (19) are accessible for testing (refer to Figure 4-4).

D. To obtain access to the Power Supply and Recorder PCB (6), lay chassis (20) with PCBs onto bottom cover (3). (Refer to Figure 4-4.)

E. If further disassembly is required, proceed to the next paragraph.

4-9. No-Fade PCB Removal. After completing the procedures in 4-8 proceed as follows:

A. Remove the flat cable connector from J2, with an I.C. Removal tool.

CAUTION

Care must be used in the handling of the flat cable connector. The pins are exposed and quite fragile. If possible press the pins into a small piece of styrofoam while disassembly is being performed.

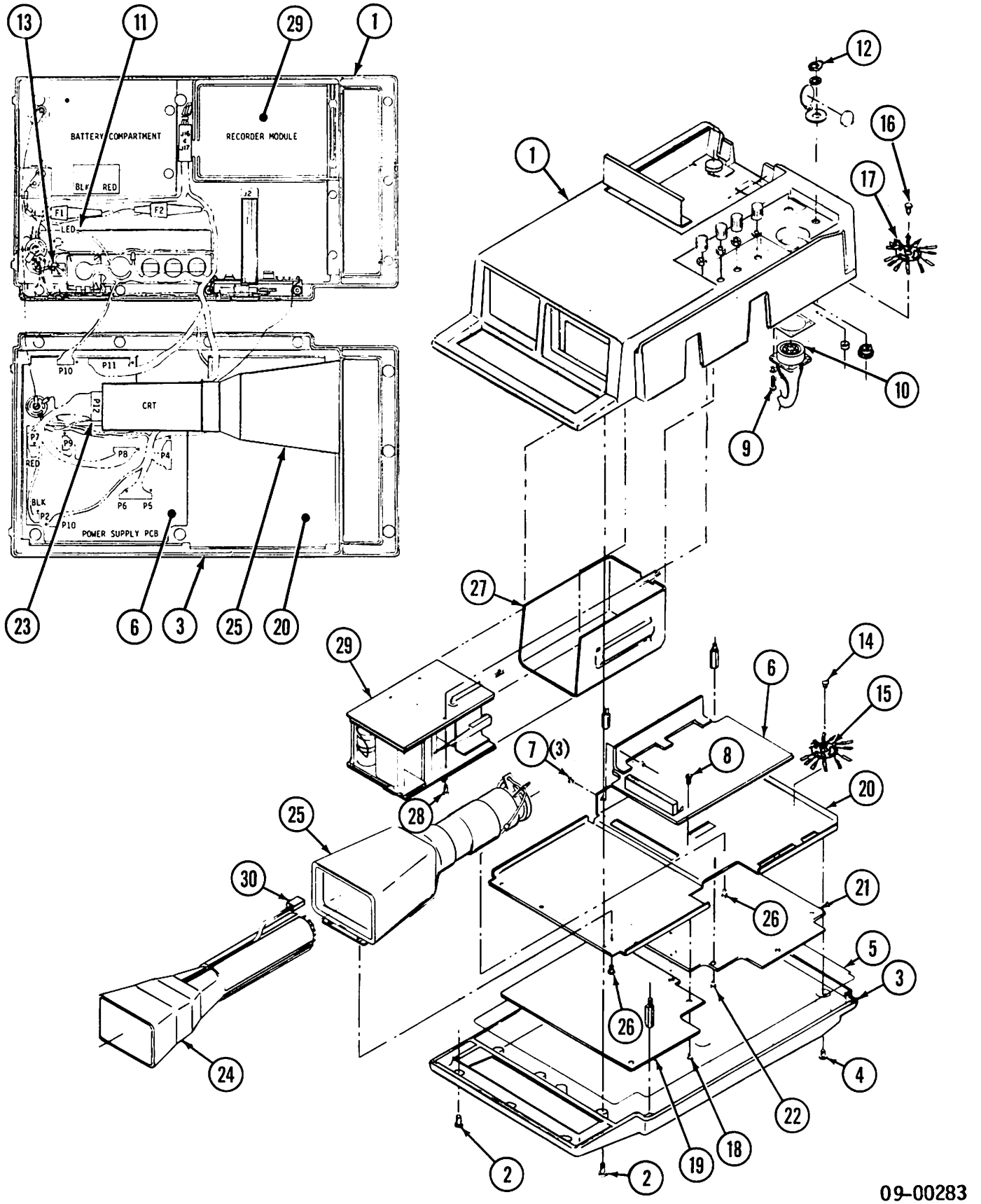


FIGURE 4-4. ECG MONITOR/RECORDER MAJOR COMPONENT REMOVAL

4-9. No-Fade PCB Removal. (Continued)

B. Remove the connector from J2.

C. Remove four screws (18) securing No-Fade PCB (19) to chassis (20).

D. Lift the PCB straight up until the pins clear J1.

4-10. Preamp PCB Removal. After completing the procedures in 4-8 and 4-9 proceed as follows:

A. Remove connectors from P11 and P10.

B. Remove six screws (22) securing Preamp PCB (21) to chassis (20).

C. Lift the PCB straight up until all pins clear their respective connectors.

4-11. CRT Assembly Removal. After completing the procedures in 4-8, 4-9 and 4-10 proceed as follows:

A. Cut the nylon tie retaining the socket.

B. Remove connector from P7.

C. Remove three screws (26) securing CRT housing (25) to chassis (20).

D. Lift off the CRT Assembly.

4-12. Power Supply and Recorder PCB. After completing procedures 4-8, 4-9, 4-10 and 4-11 proceed as follows:

A. Disconnect eight connectors (P2, P4, P5, P6, P7, P8, P9 and P10).

B. Remove three screws and kepnuts (7) that secure the Heat Sink to chassis (20).

C. Remove two screws (8) that secure the PCB to the chassis.

D. Lift the PCB straight up until all pins clear their respective holes.

4-13. Wire Harness Assembly Removal. After completing the procedures in 4-8, and 4-9 proceed as follows:

A. Disconnect P4, 5, 6 and 10 from the Power Supply and Recorder PCB.

B. Remove screw (14) that secures ground ring (15) to chassis (20).

C. Remove connectors from P10, P11 and P12 on the Preamp PCB and J2 and P18 on the No-Fade PCB. There should not be any other connections between the upper case assembly and the chassis; so the chassis may be set aside until the unit is reassembled.

D. Remove the battery terminal connectors.

4-13. Wire Harness Assembly Removal. (Continued)

E. Disconnect J16 and J17 to the recorder (29).

F. Remove screw (16) that retains ground ring (17) to the upper case assembly.

G. Remove low battery indicator (11) retaining ring which is located on the outside of the unit near the ECG OUT jack. After removing the retaining ring the socket may be removed from the inside of the case. The hole around the socket is sealed with RTV SILASTIC. It can be pulled or cut off, it must be resealed upon reassembly.

H. Remove knobs and mounting hardware from the Power/Mode ECG SIZE/FREEZE, CAL/VOL and RECORD/HEAT controls. The controls may be removed from their mounting holes.

I. Remove four screws (9) from patient cable connector (10). The patient cable connector and Voltage Surge Protector PCB may now be removed.

K. Remove ECG Out Jack Retaining Nut (12) and remove ECG Out Jack (13) from its hole. The Wire Harness Assy should be free from upper case assembly.

4-14. Synchronizer PCB Removal. After completing the procedures of 4-8 proceed as follows:

A. Remove the flat cable connector from U2 on No Fade PCB with an I.C. removal pool.

B. Remove two standoffs securing the Synchronizer PCB to uppercase assembly (1). The PCB may now be repositioned to facilitate wire removal.

NOTE: Mark the wires so they can be returned to correct WP.

C. Desolder wire points WP 1-4 and detach wires, PCB may now be removed.

4-15. Recorder Removal Procedure. After completing the procedures in 4-8 proceed as follows:

CAUTION

The ECG Monitor/Recorder unit is sealed environmentally from the Recorder chassis. To remove the Recorder, the sealed outer Recorder housing must first be removed. If facilities are not available to reseal the Recorder, it is suggested that the repair be done by a Physio-Control Field Service Representative. Improper sealing would seriously jeopardize the Unit and the warranty. The Recorder is also aligned to close tolerances. Any disassembly would require Recorder alignment.

4-15. Recorder Removal Procedure. (Continued)

A. The Recorder enclosure is sealed with RTV adhesive/sealant which must be cut away before the enclosure can be removed. A long, thin, sharp cutting tool, such as a small pocket knife or scalpel can be used. Cut around the edges of the enclosure, avoid cutting the control wires.

B. The enclosure can now be removed.

C. Remove the three slotted retaining screws from the recorder.

D. The last screw to be removed is a flathead screw which can be removed via an access hole in the top of the recorder with the paper carrier pulled out.

E. Disconnect P16 and P17 from the wire harness and lift the recorder out of the unit.

4-16. Recorder Removal and Stylus Replacement. After completing procedures in paragraph 4-15, proceed as follows:

A. Remove Recorder cable harness connections.

B. Using a sharp tool, such as an exacto knife, cut away RTV sealant from protective environmental cover (27). Remove cover (27).

C. Remove 4 screws (28) and remove Recorder (29).

D. Remove the stylus by gently sliding it towards the front of the recorder.

E. After replacing the stylus refer to paragraph 4-55 to adjust the stylus pressure.

NOTE: Reseal the Recorder housing with RTV Adhesive/Sealant before closing the case. Moisture must be prevented from entering the case.

4-17. Major Component Removal And Installation. (Defibrillator)

The following procedures provide the sequence for removing and installing the major components of the DC Defibrillator.

Installation is for the most part the opposite of removal so only the removal procedures are provided. Special installation notes are provided as required. Remove or disassemble only to the point required. Figure 4-5 provides an exploded view of the Defibrillator to assist in the following procedures.

CAUTION

Special Handling of PCB assemblies containing Electrostatic Sensitive Devices (ESD's) ATTENTION is required.

4-18. Upper and Lower Case Separation. Refer to Figure 4-5 and proceed as follows:

NOTE: Installation procedures are essentially the reverse of the procedures presented below. When joining the two cases, be careful to have gasket positioned correctly.

A. Remove 11 screws (1) securing upper case (2) to lower case (3). Note different length of screws. Use caution when reinserting screws.

CAUTION

Before removing top cover, observe location of Charge Storage Capacitor, Coil and Transfer Relay (refer to Figure 4-27). Keep hands clear of those areas.

B. Carefully lift top case (2) straight up and to the side of lower case. The wiring harness will keep the 2 halves from being able to be pulled completely apart. Use care not to damage top to bottom cover gasket.

C. Using a 20K, 20W resistor on the end of a high voltage probe, insure that the Charge Capacitor is discharged. Do not use a screwdriver in place of the above.

D. The unit is now in the test configuration (refer to Figure 4-27). If further disassembly is required, proceed to paragraph 4-19.

4-19. General Disassembly. Refer to Figure 4-5 and proceed as follows:

NOTE: Installation procedures are essentially the reverse of the procedures presented below.

A. To remove Main PCB (5), disconnect 6 connectors J1 through J6 from PCB connector. Using tip of screwdriver, lift Main PCB (5) free of clips (6) and remove from unit.

B. To remove Charge Storage Capacitor (8), with Coil (9) simply lift unit up and out after disconnecting slide-on clips connected to terminals. Coil (9) is connected to Capacitor (8) with double back tape.

C. To remove Transfer Relay (10) , desolder wires connected to it and lift unit up and out.

D. If Paddles require removal, refer to paragraph 4-20

4-20. Paddle Removal (Figure 4-6). After completing procedures in paragraph 4-18 proceed as follows:

NOTE: Installation procedures are essentially the reverse of the procedures presented below.

A. Disconnect connector J3. Remove pins 1 through 7 (with wires connected) from J3.

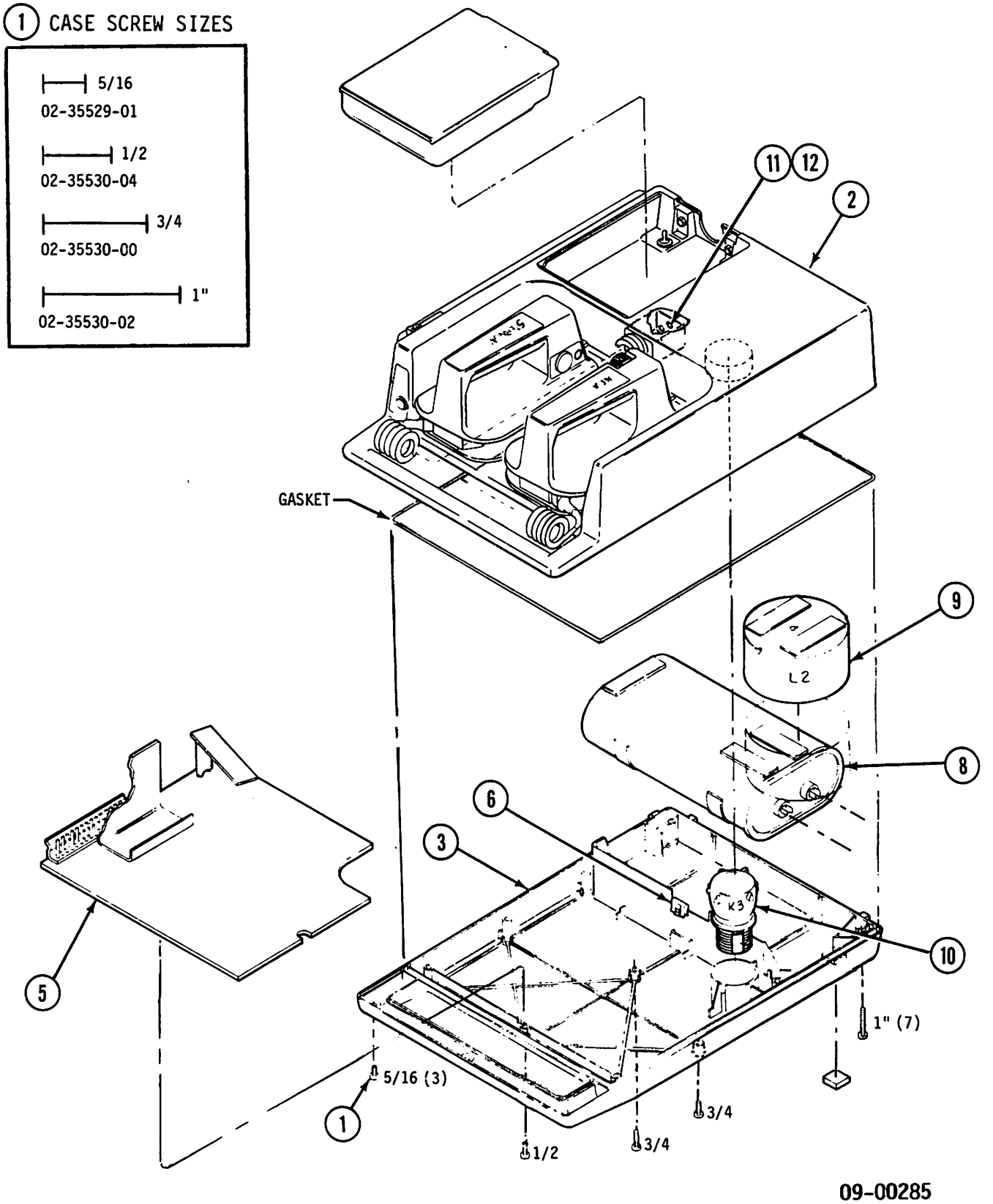


FIGURE 4-5. DC DEFIBRILLATOR MAJOR COMPONENT REMOVAL

4-20. Paddle Removal (Figure 4-6). (Continued)

B. Unsolder wires connected to Transfer Relay (10) contacts C1 (red) and C2 (red and white).

C. Using small screwdriver from underneath top case push strain relief (11) out of hole.

D. Cut tie (12).

E. Pull paddle wiring free of unit.

4-21 Major Component Removal And Installation. (Paddles)

The following procedures provide the sequence of removing and installing major components of the Defibrillator Paddles (p/n. 801271-05 and on).

NOTE: Defibrillator Paddles p/n. 801271 below -05 are not repairable. Check p/n before attempting the following procedures.

Disassemble and remove parts only to the extent required for repair or replacement. Figure 4-6 provides exploded views of the Defibrillator Paddles to assist in these procedures.

4-22. Removal of Top Label.

A. Top label (1) is held quite firmly to top cover (2) with a self adhesive. When removing label, care must be taken to avoid damaging paddle top.

B. Carefully insert a thin-tipped-tool between the edge of the label and paddle top near corner. Gently pry label away until sufficient access exists to allow pulling with fingers.

C. Using fingers, pull label completely free of paddle. Discard label.

4-23. Installation of Top Label.

A. Use correct label per drawing 800917.

B. Peel paper off of self adhesive backing.

C. Orient label over paddle handle. Carefully lay rear end of label down into label recess, checking for proper alignment. Lay label completely down into recess.

D. Press and rub label firmly into recess to ensure good adhesion. Be careful not to soil the label.

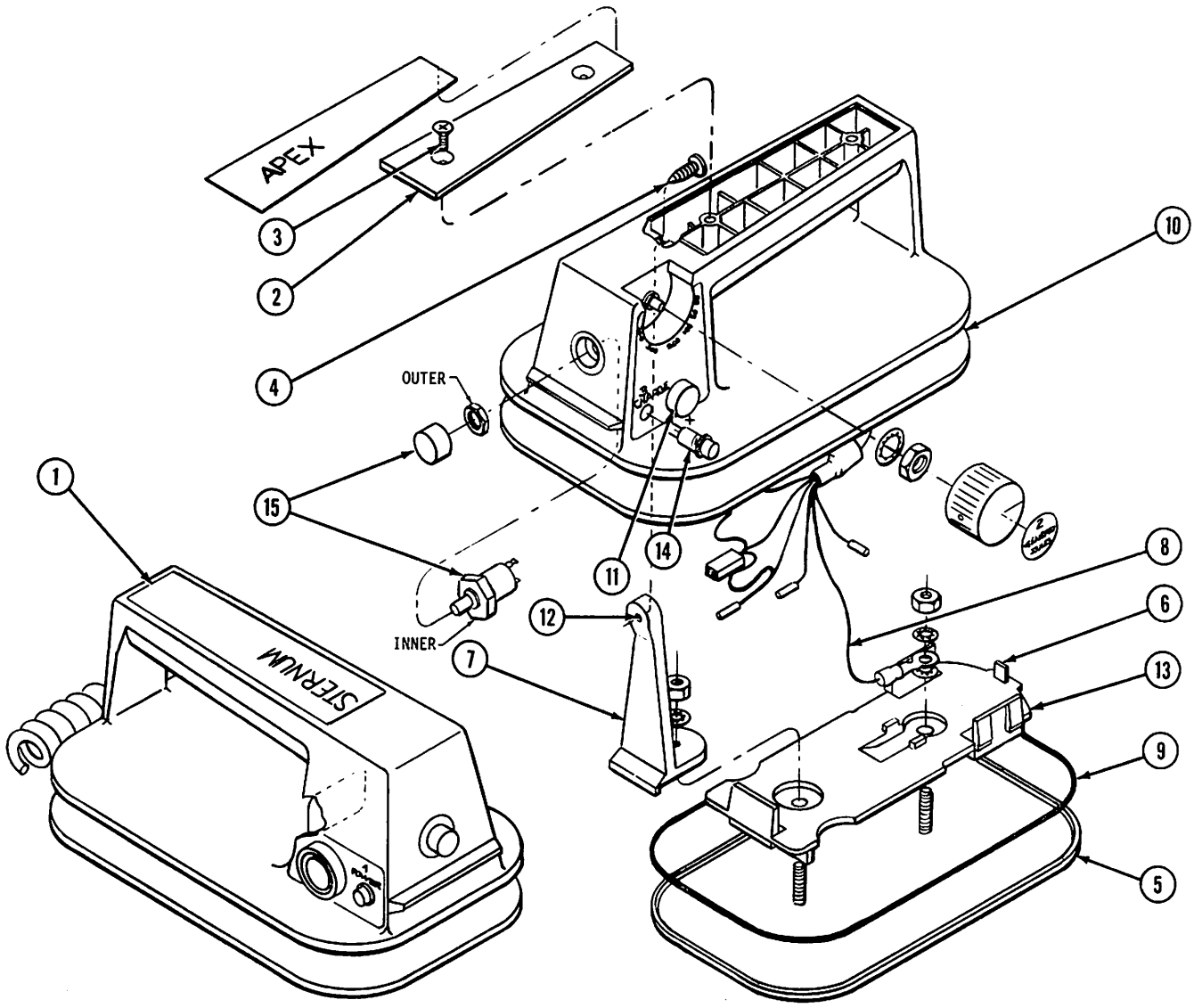


FIGURE 4-6. PADDLE REPLACEABLE PARTS REMOVAL

4-24. Removal of Electrode Plate Assembly. (Platen)

A. Remove top label per paragraph 4-22.

B. Remove two screws (3) holding top cover (2) in place. Remove the cover.

C. Remove screw (4) from under the top cover. (The screw may be surrounded by RTV which should also be removed.) Turn paddle upside down.

D. Carefully pry electrode plate (5) away from base at front of side of paddle, using a wide, thin-tipped-tool. See Figure 4-7. Try to minimize damage to paddle base. Front end of electrode plate assembly will "pop" partially away from base.

4-24. Removal of Electrode Plate Assembly. (Platen) (Continued)

E. Use fingers to pull electrode plate assembly forward and away from base, until tab (6) at rear of retainer clears edge of paddle base. (Retainer bracket (7) is bent against side switch in this step.) See Figure 4-6. Electrode plate assembly should fall readily away from paddle base at this point. Take care not to stress high voltage wire (8) attached to electrode plate assembly. The rubber O-ring (9) is loose and should be replaced if damaged.

4-25. Installation of Electrode Plate Assembly.

A. Place paddle upside down.

B. Check to see that electrode plate assembly is properly assembled (refer to Figure 5-12). Whenever electrode plate assembly is removed, retainer and retainer bracket must be replaced (refer to step F). Also mark and identify location of wire connections.

C. Check to see that coil-cord wire connections are correct (refer to Figure 6-6).

D. Route wires so they do not block path of retainer bracket arm (7) into upper cavity and will not interfere with seating of electrode plate assembly into paddle base.

E. Place O-ring (9) in recess of paddle base.

F. Insert retainer bracket arm (7) most of the way into paddle handle cavity, between side switch and back wall of cavity. Push assembly forward, bending arm against side switch, until retainer tab (6) can clear edge of base at rear. Push rear of assembly down and then back, catching tab under edge of base. Push front of assembly down until it snaps into base.

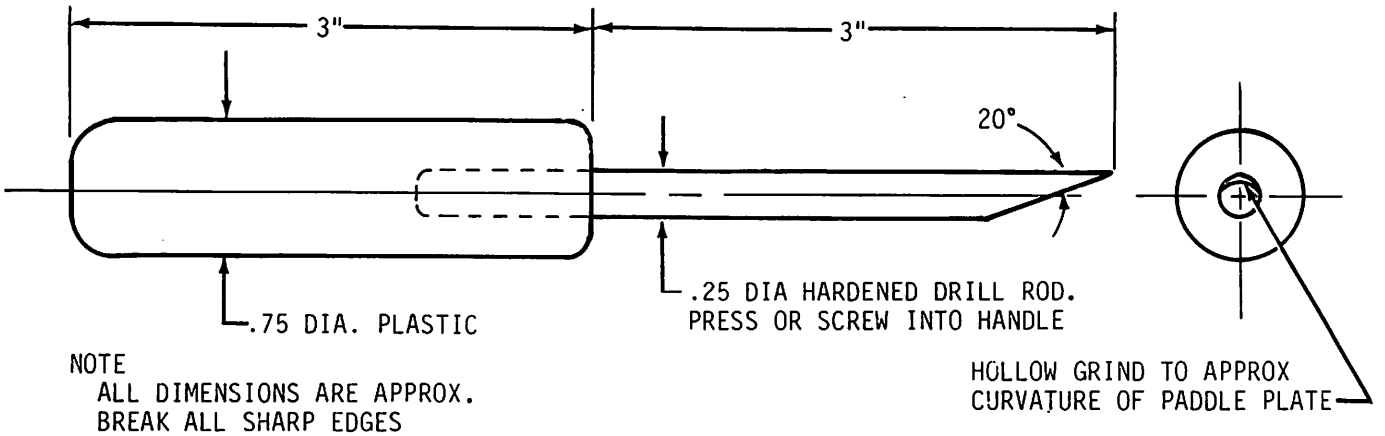


FIGURE 4-7. PRY BAR FOR REMOVING PLATENS

4-25. Installation of Electrode Plate Assembly. (Continued)

G. Turn paddle over.

H. Install screw (4) through hole in back wall of upper cavity into hole (12) in top of retainer bracket arm. Make sure screw has threaded itself into bracket (it should "bottom out" noticeably). Cover screw with RTV.

I. Install top cover (2) into recess in paddle handle.

J. Install two screws (3) to hold top cover.

K. Install top label per paragraph 4-23.

4-26. Disassembly of Electrode Plate Assembly.

A. Remove electrode plate assembly per paragraph 4-24.

B. Remove RTV from nuts and surrounding areas.

C. Remove nuts, lockwashers, and hi voltage terminal.

D. Disassemble and discard retainer (13) and retainer bracket (7). Discard electrode plate (5) if it is severely pitted or scratched.

4-27. Assembly of Electrode Plate Assembly.

A. Assemble new retainer (13) and new retainer bracket (7), electrode plate (5) (new if required), nuts, lockwashers, and high voltage terminal. (See Figure 5-12.)

B. Apply RTV to nuts. Allow 24 hours minimum cure time.

4-28. Removal of Coil Cord Assembly.

A. Remove electrode plate assembly per paragraph 4-24.

B. Using needlenose pliers, carefully remove all terminals from respective components.

C. Turn paddle right side up. Using a sharp, triangular knife, (Xacto blade numbr 11), sever the coil cord at the point where the strain relief meets the outside of the base. Turn paddle upside down. Discard short piece of coil cord from inside paddle.

D. Using standard procedure, remove other end of coil cord from defibrillator case and discard. (See paragraph 4-20.)

4-29. Installation of Coil Cord Assembly.

A. Lightly wet the inside diameter of strain relief hole with water. This serves as a lubricant.

B. Feed paddle end of coil cord assembly through hole.

4-29. Installation of Coil Cord Assembly. (Continued)

C. Orient strain relief, then pull it into place, pulling cord from inside. This may take a significant amount of force, as the fit is quite tight. Avoid straining coil cord more than necessary. A rocking motion may be used to fully seat strain relief.

D. Using needlenose pliers, connect coil cord terminals to their respective components in the paddle, (see Figure 6-6).

E. Install electrode plate assembly per paragraph 4-25.

F. Using standard procedure (see paragraph 4-20), install defib end of coil cord into defib and button up the unit.

4-30. Removal of Side Switch. (11)

A. Remove electrode plate assembly (5) per paragraph 4-24.

B. Move coil cord wires clear of side switch leads.

C. Using needlenose pliers, carefully pull coil cord terminals off side switch.

D. Remove pushbutton (11) .

E. Grip inner nut of switch with pliers or wrench. Use 5/16" Hex socket to remove outer nut.

F. Remove switch.

4-31. Installation of Side Switch.

A. Bend leads of new switch per Figure 5-12.

B. Remove pushbutton and insert switch (11) into hole in paddle.

C. Being careful not to damage coil cord wires, grip inner nut with pliers or wrench. Use 5/16" Hex socket to install outer nut. Be sure to orient switch leads per Figure 5-12.

D. Install pushbutton.

E. Using needlenose pliers, connect coil cord terminals to switch leads.

F. Install electrode plate assembly per paragraph 4-25.

4-32. Removal of LED. (14)

A. Remove electrode plate assembly per paragraph 4-24.

B. Clear coil cord wires to allow access to LED (14) .

C. (APEX only) Using needlenose pliers pull connector housing off PCB.

4-32. Removal of LED. (14) (Continued)

D. Using needlenose pliers, pull terminals off of the LED.

E. Use standard pliers to pull LED out of paddle from the outside. (This may require destruction of LED, since the snap-fit is usually quite tight.)

F. Clear any pieces of LED from inside paddle cavity.

4-33. Installation of LED. (14)

A. Trim LED leads: cathode (+) 3/10"; other (-) 2/10". Install with cathode lead to the rear of paddle.

B. Using needlenose pliers, feed LED coil cord terminals out through LED hole.

C. Connect terminals to LED. (See Figure 5-12.)

D. (APEX only) Using needlenose pliers, connect PCB connector housing to PCB.

E. Feed LED (14) and wires back into hole, and snap LED into place.

F. Install electrode plate assembly per paragraph 4-25.

4-34. Removal of Front Switch. (15)

A. Remove side switch (11) per paragraph 4-30.

B. (APEX only) Move coil cord wires clear of PCB and front switch.

C. (APEX only) Using needlenose pliers, pull connector housing off PCB.

D. Using needlenose pliers, pull the terminals off front switch.

E. Remove pushbutton (15) .

F. Grip inner nut of switch with pliers or wrench. Use 5/16" Hex socket wrench to remove outer nut.

G. Remove switch.

4-35. Installation of Front Switch.

A. Bend leads of new switch down to fit.

B. Remove pushbutton and insert switch into paddle.

C. Being careful not to damage coil cord wires, grip inner nut with pliers or wrench. Use socket to install outer nut. Be sure to turn switch leads so they point downwards.

4-35. Installation of Front Switch. (Continued)

D. Install pushbutton.

E. Using needlenose pliers, connect coil cord terminals to switch leads. See Figure 6-6.

F. (APEX only) Using needlenose pliers, connect PCB connector housing to PCB.

G. Install side switch per paragraph 4-31.

4-36. Replacement of Side Label.

These procedures are very similar to paragraphs 4-22 and 4-23.

4-37. Major Component Removal And Installation. (Battery Charger 09-00284)

The following procedures provide the most logical sequence of removing and installing major components of the Battery Charger. Installation is for the most part the opposite of removal so only removal procedures are provided. Special installation notes are provided as required. Remove or disassemble only to the point required. Figure 4-8 provides an exploded view of the Battery Charger to assist in the following procedures. Proceed as follows:

NOTE: Installation procedures are essentially the reverse of the procedures presented.

A. Remove 6 screws (2) securing upper case (1) to chassis (4).

B. Carefully lift upper case (1) straight up and lay it to the side of lower case. The wiring harness will keep the two halves from being able to be pulled completely apart. The unit is now disassembled far enough to facilitate testing.

C. If required, chassis (4) may be removed from lower case (3) by removing four screws (5).

D. To remove main PCB (6), remove 4 screws (7) securing PCB to chassis (4) and 3 nuts (8) securing it to heat sink. Disconnect 3 connectors.

E. To remove Test Load PCB (9), remove 2 nuts (10) and 5 connectors. The TEST LOAD Indicator may either be unsoldered or removed from cover by removing attaching hardware.

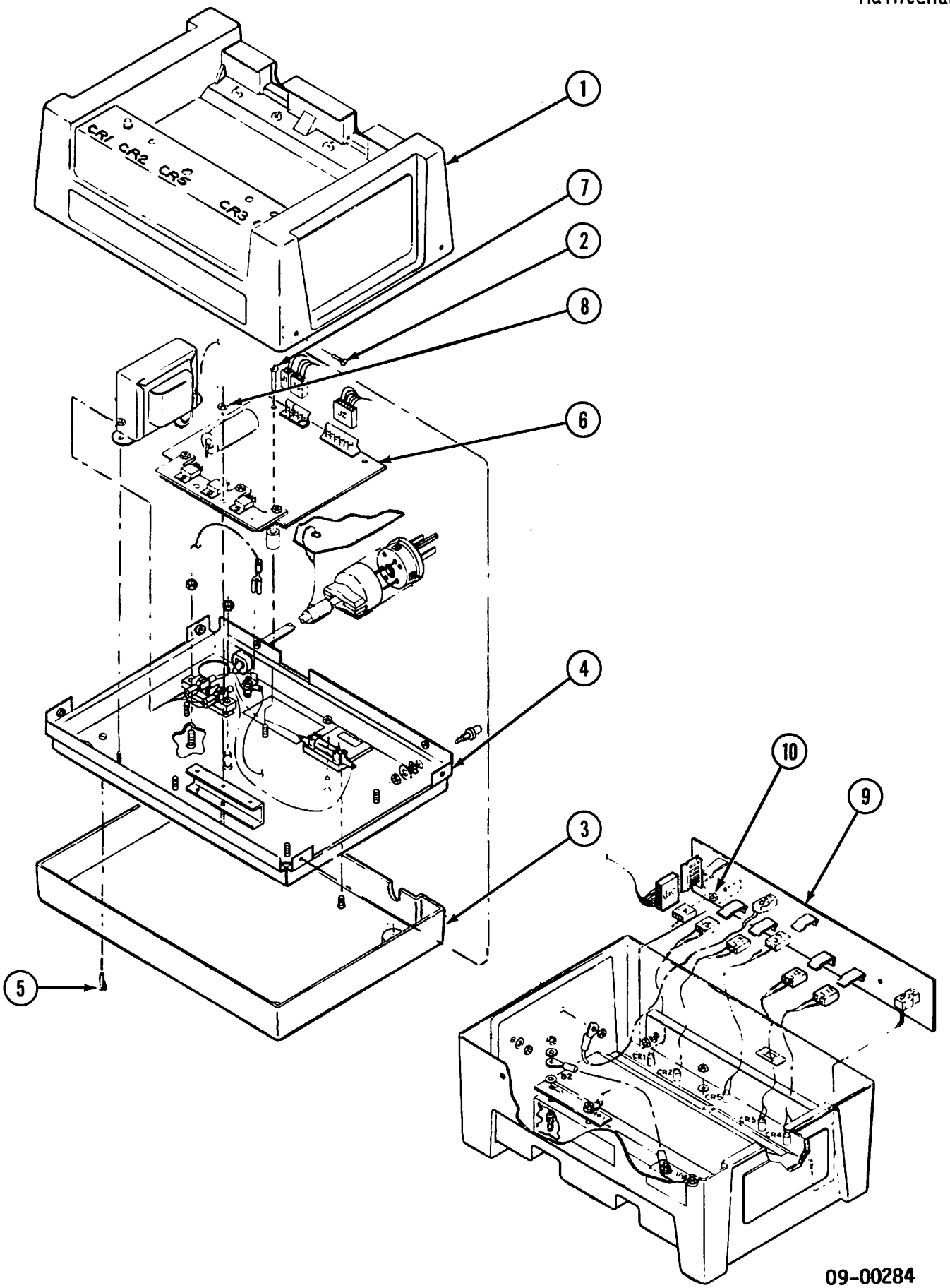


FIGURE 4-8. BATTERY CHARGER MAJOR COMPONENT REMOVAL

4-38. ECG MONITOR/RECORDER UNIT.

Procedures in this section are divided into the following topics: Functional Checks, Troubleshooting, Component Identification, and Test and Calibration.

4-39. Functional Checks.

These checks can be performd with the ECG Monitor/Recorder Unit closed, and should be carried out to decide if it is necessary to open the unit for repair or recalibration.

A. Power Supply.

1. Low Battery Level Circuit Check.

a. Remove the Battery Pak.

b. Connect the DC Power Supply (Table 4-1, 1) to battery terminal posts on the monitor, observing correct polarity.

c. Set the external DC Power Supply to 12.5V, using Digital Multimeter (Table 4-1, 2) as a voltmeter.

d. Set all ECG Monitor/Controls to minimum or OFF.

e. Turn Pwr/Mode select to PADDLES. Check that Monitor is ON.

f. Slowly reduce the voltage on the external DC Power Supply until low battery indicator lamp begins to flash.

g. Check that the supply voltage at this point is between 10.0 to 10.25Vdc.

2. Minimum Current Check.

a. Remove Battery Pak.

b. Set DC Ammeter (Table 4-1, 3) to read more than 2 amperes full scale. Connect DC Ammeter between DC Power Supply (Table 4-1, 1) and positive terminal on monitor. Connect DC Power negative supply to negative terminal.

c. Adjust DC Power Supply to 12.5V using Digital Multimeter (Table 4-1, 2) as a voltmeter.

d. Set all Monitor controls to OFF, or minimum setting.

e. Set Pwr/Mode select to II and check that Monitor is ON.

f. The DC Ammeter should read less than 490mA. If the current exceeds 490mA, perform Power Supply Tests in paragraph 4-45.

g. Turn Pwr/Mode select to POWER OFF.

4-39. Functional Checks. (Continued)

A. Power Supply. (Continued)

3. Maximum Current Check.

a. Retain the power connections as described in 4-39 A. 1, above.

b. Connect Function Generator (Table 4-1, 5) to 3-LEAD PATIENT CABLE connector with the Preamp Input fixture (Figure 4-12). Adjust Function Generator for a sinewave output of 10Hz, 1V p-p.

c. Turn the ECG SIZE, HEAT and SYST VOL to maximum (fully clockwise).

d. Set Pwr/Mode select switch to II.

e. Depress RECORD power switch. Check that paper drive motor runs.

f. Observe DC Ammeter, the current should rise suddenly to 1.9A and then settle at 1.2A.

g. Turn Pwr/Mode select switch to OFF.

h. Disconnect DC Ammeter from Battery Pak trminal, and DC Power Supply.

Disconnect all other test equipment.

WHEN POWER SUPPLY FUNCTION TESTS INDICATE TROUBLE, REFER TO "TESTS AND CALIBRATION", POWER SUPPLY TESTS, paragraphs 4-45 AND 4-46.

B. CRT Checks.

1. Horizontal Sweep.

a. Connect Patient Cable to 3-LEAD PATIENT CABLE Connector and connect Red and White leads together. Turn ECG SIZE Control to minimum (fully counterclockwise).

b. Turn Pwr/Mode select (ECG LEAD) to II and check that the trace on CRT is parallel and is about 0.8" from bottom of screen mask.

C. Preamplifier Gain Check.

1. Connect Function Generator (Table 4-1, 5) to patient cable connector with the Preamp Input Fixture (Figure 4-12) and adjust the output for a 10Hz, 1V p-p sinewave.

2. Check that Pwr/Mode select (ECG LEAD) is set to II.

4-39. Functional Checks. (Continued)

C. Preamplifier Gain Check. (Continued)

3. Connect Oscilloscope (Table 4-1, 4) to ECG OUT 1V, (the tip connection of the ECG OUT jack).

4. Observe Oscilloscope display and check that the signal at ECG OUT is 10Hz, 1V ± 10% p-p sinewave and is clean and undistorted.

5. Disconnect Oscilloscope.

6. Retain other connections if ECG gain is to be checked.

D. Minimum and Maximum ECG Gain.

1. With connections as described in paragraph 4-39 C, proceed as follows:

2. Set ECG SIZE to maximum (clockwise).

3. Check that 80% of Monitor CRT screen is filled.

4. Adjust ECG SIZE to minimum (counter-clockwise).

5. Increase the output of Function Generator to 10V. All parts of the sinewave should be visible on Monitor CRT screen.

6. Change the frequency of Function Generator to 2Hz. Check that no distortion or clipping of the waveform occurs on Monitor CRT.

7. Retain test set-up if Preamp noise is to be checked.

E. Preamp Intrinsic Noise Check.

1. Adjust Function Generator to give an output of 10Hz, 1mV p-p sinewave.

2. Check that Pwr/Mode select (ECG LEAD) is set to II.

3. Replace Preamp Test Fixture with Patient Cable and connect 25K resistors to RA, LA, and LL leads as shown in Figure 4-16.

4. Observe the noise displayed on Monitor CRT in ECG LEAD positions I, II and III in turn. The peak-to-peak noise must be less than 1mm.

When ECG Preamplifier Functional Tests indicate trouble, refer to "Tests and Calibration", Preamplifier Gain and Frequency Response, paragraph 4-48.

F. Recorder Checks.

1. Connect Preamp Input Fixture to Function Generator, and Oscilloscope, all in parallel using the BNC T-connector.

4-39. Functional Checks. (Continued)

F. Recorder Checks. (Continued)

2. Connect Preamp Input Fixture to 3-LEAD PATIENT CABLE connector on ECG Monitor/Recorder.

3. Pre-set Function Generator output for 1V p-p sinewave, 10Hz, and then turn it OFF.

4. Check that Pwr/Mode select (ECG LEAD) is set to II. Set ECG control for 1cm deflection on Monitor CRT.

5. Push RECORD switch on and check that chart trace is centered on the paper.

6. Turn on Function Generator and observe sinewave peak-to-peak on recorder chart. It should be 10mm ± 1mm. Stop Recorder.

7. Adjust ECG SIZE control to display 3cm deflection on Monitor CRT. Turn Recorder back on. The Recorder chart trace should not be more than 2.8cm, p-p.

8. Turn off Recorder. Observe the output of Function Generator with Oscilloscope. Verify that it is an accurate 1V p-p sinewave. During the rest of this test, maintain this output accurately on Oscilloscope.

9. Turn on Recorder and reduce ECG SIZE to 1cm height.

10. Vary the frequency of Function Generator from 0.5Hz to 40Hz (on 60Hz units) and from 0.5Hz to 35Hz (on 50Hz units).

    Check that trace on recorder chart does not fall below 7mm p-p.

11. Turn off Recorder.

G. Recorder FREEZE Check.

1. Retain the test set-up described in paragraph F. 1 through 4 above. Turn off Function Generator.

2. Check that Monitor CRT displays a clean line on the screen.

3. Turn on Recorder. Check that Monitor CRT and chart recorder trace show a straight clean line.

4. Depress FREEZE control. Note that the lines on both are still clean and straight. Depress FREEZE control again.

5. Turn off Recorder.

6. Check that the Function Generator is set to give 10Hz, 1V p-p sinewave, but do not turn it on.

4-39. Functional Checks. (Continued)

G. Recorder FREEZE Check. (Continued)

7. Turn on Recorder again, then turn on Function Generator. The sinewave should appear first on the Monitor CRT, then after a short delay, it should be recorded on chart recorder.

   This shows that Recorder delay circuit is operating correctly.

8. Next, depress FREEZE control. This arrests CRT display, while chart recorder continues running.

9. Turn off Function Generator. Check that CRT display, and chart trace revert to a straight line simultaneously.

10. Turn off Recorder, and remove test equipment. Turn off ECG/Monitor Recorder.

H. 1mV Cal.

1. Connect Function Generator output to 3-LEAD PATIENT CABLE connector with Preamp Input Fixture.

2. Set the Function Generator output for 1V p-p, 1Hz squarewave.

3. Set Pwr/Mode select (ECG LEAD) to II position, depress RECORD control.

4. Adjust ECG SIZE control for a 1cm deflection on Recorder trace. Turn off Function Generator.

5. Depress the CAL pushbutton and observe chart recorder trace. The height of calibration pulse should be .1cm.

6. Turn off Recorder and ECG Monitor.

I. Recorder Stylus Checks.

1. Set Pwr/Mode select (ECG LEAD) switch to II.

2. Connect Patient Cable to 3-LEAD PATIENT CABLE connector and connect Red and White leads together and verify CRT display shows a clean and flat trace.

3. Turn on Recorder and adjust stylus HEAT control for a satisfactory trace.

4. Adjust ECG SIZE control to obtain a 1cm high CAL pulse on chart recorder.

5. See Figure 4-11 for Recorder Waveforms.

6. Turn off Recorder, and ECG Monitor.

4-40. Troubleshooting. Observe the ECG Monitor/Recorder for obvious symptoms such as odors from overheated components or mechanical malfunctions. Use Table 4-2, Troubleshooting, to isolate and identify malfunctions. If corrective action refers to a particular test or calibration, find the reference in paragraphs 4-43 through 4-57. Refer to paragraph 4-7 if unit is to be opened.

WARNING

TERMINALS AND WIRES CARRYING HIGH DC VOLTAGES ARE EXPOSED WHEN THE LIFEPAK 5 COVERS ARE REMOVED. OBSERVE SAFE WORKING TECHNIQUES. BE CAREFUL DURING TROUBLESHOOTING, TESTS AND CALIBRATION OR COMPONENT REMOVAL AND INSTALLATION.

CAUTION

Special Handling of PCB assemblies containing Electrostatic Sensitive Devices (ESD's) is required.

4-41. Test Equipment. Test instruments suitable for maintenance and calibration of the LIFEPAK 5 units are listed in Table 4-1. Although certain commercially available test instruments are recommended, other TEST EQUIPMENT WITH SPECIFICATIONS EQUIVALENT TO THOSE LISTED MAY BE USED.

4-42. Component Identification. Figure 4-1 provides an overall open view of LIFEPAK 5 ECG Monitor/Recorder unit with key components and test points or adjustments indexed to a legend. Refer to paragraph 4-7 for Major Component Removal And Installation, and information on how to open unit for test. Refer to Section 5 for an interconnecting wiring diagram. Controls and connectors located on the ECG Monitor/Recorder top panel are designated in the text by the exact name shown on the instrument and appear in capital letters with the component number following. For example: FREEZE switch S2. Refer to Section 5 for component location.

4-43. Tests and Calibration.

Procedures given here are used to verify that the ECG Monitor/Recorder is operating within specifications. Table 4-2, Troubleshooting, contains references to these procedures. If the instrument is not functioning properly, locate the malfunction before attempting circuit calibration or adjustment. Refer to paragraph 4-42 for information concerning component location. Test equipment is referenced ( ) to Table 4-1.

TABLE 4-1

TEST EQUIPMENT REQUIRED

ITEM NO.	TEST EQUIPMENT	SPECIFICATIONS
1.	DC Power Supply Deltron Model SP20-10	Output Voltage Variable: 0 to 20Vdc Output Current: Variable 0 to 10 Amperes
2.	Digital Multimeter, Fluke Model 8000A with High Voltage Probe	Range: 0 to 1500V full scale. Accuracy: 0.5% of full scale on dc volt and resistance ranges, 1% of reading on AC voltages. Input Resistance: 10MΩ
3.	DC Ammeter, VOM, Triplett 630	Sensitivity: 20KΩ per volt ±3% 10A dc and 5KVdc
4.	Oscilloscope, Tek- tronix Model 7603 with Dual Trace Amplifier 7A18N and Dual Time Base 7B53AN	Bandwidth: dc to 10MHz Vertical Sens: 1mV/div to 10V/div Sweep Range: 0.05mV/div to 5sec/div
5.	Function Generator, Wave-Tek Model 130	Frequency Range: 1 to 400Hz Accuracy: ±2% Power Output: 160mW (10V) into a 600Ω load
6.	Defibrillator Energy Meter, Dempsey Model 429	Power Range: 0-400 watt-seconds Load Resistance: 50Ω ±1% Accuracy: ±3% of full scale for pulse width of 5m
7.	Stopwatch	Accuracy: ±0.25 sec
8.	Variable Resistor	40-60Ω 40W
9.	Variable Auto- transformer	0-130V 0-240V
10.	6 inch scale	Graduated in 8ths or 100ths
11.	ECG Simulator	306pm to 2806pm
12.	BNC T connector	Pomona Electronics #3285
13.	Preamp Input Fixture	**NOTE:** This item may be constructed using the schematic and parts list of Figure 4-12.

TABLE 4-2

ECG MONITOR/RECORDER UNIT TROUBLESHOOTING

MALFUNCTION	POSSIBLE CAUSE	CORRECTIVE ACTION
1. Unit does not function when Pwr/Mode select switch is not at PWR off.	a. Battery discharged below operating level.	a. Replace Battery/Pak (Low Battery indicator will flash).
	b. Defective fuse F1.	b. Replace if necessary. If fuse opens when power is applied, check for short circuit in system Power Supply.
	c. Defective system power supply.	c. Perform Power Supply Tests, paragraph 4-45.
2. No luminous trace on ECG Monitor.	a. Defective CRT sweep/deflection circuits.	a. Perform CRT trace checks and adjustments, paragraph 4-47,
	b. Defective CRT high voltage power supply.	b. Perform Power Supply Tests, paragraph 4-45.
	c. Defective CRT.	c. Replace CRT.
3. Interference on CRT trace when using patient cable as ECG pickup.	a. Poor electrode contact or placement.	a. Inspect electrode faces and reposition on patient.
	b. Electrode GEL evaporated.	b. Check expiration date on electrodes.
	c. Defective patient cable.	c. Replace patient cable.
	d. Defective common mode rejection circuit in pre-amplifier.	d. Perform Preamplifier checks and adjustments in paragraph 4-48.
4. Excessive 60Hz interference on CRT when using external paddles as ECG pick-up.	a. Defective paddles.	a. Replace paddles.
	b. Defective slide contacts.	b. Check slide contacts on both units for physical damage and cleanliness.

TABLE 4-2 (Continued)

ECG MONITOR/RECORDER UNIT TROUBLESHOOTING

MALFUNCTION	POSSIBLE CAUSE	CORRECTIVE ACTION
4. (Continued)	c. Defective transfer relay.	c. Check transfer relay contacts for continuity (see Defibrillator Troubleshooting).
	b. Defective 60Hz Notch Filter.	b. Perform preamplifier checks and adjustments in paragraph 4-48.
5. No ECG signal on CRT when using patient cable, but 1mV CAL display is available.	a. Defective patient cable.	a. Check continuity of patient cable, or replace.
	b. Defective preamplifier circuits.	b. Perform preamplifier adjustments and checks, paragraph 4-48.
	c. Defective wire-harness or lead selector.	c. Check continuity of wire harness and selector.
	d. ECG/Voice Recorder Play Enable circuit defective.	d. Check U10b as given in paragraph 4-48 D.
6. No ECG signal on CRT when using paddles for ECG pickup, but CAL display is available.	a. Defective paddles.	a. Replace paddles.
	b. Defective interconnect.	b. Clean connector. Replace connector.
	c. Defective transfer relay.	c. Replace transfer relay.
	d. Defective Mode Select switch.	d. Replace switch.
7. Fuzzy or dim CRT trace.	a. Misadjusted CRT operating voltages.	a. Perform CRT adjustments, paragraph 4-47.
	b. Poor connection at CRT connector.	b. Clean CRT pins.
	c. Defective H.V. Power Supply.	c. Perform Power Supply Tests.

TABLE 4-2 (Continued)

ECG MONITOR/RECORDER UNIT TROUBLESHOOTING

MALFUNCTION	POSSIBLE CAUSE	CORRECTIVE ACTION
8. Persistantly noisy CRT trace, or permanent off-set.	a. Defective voice recorder, ECG playback circuit.	a. Check U10a, paragraph 4-48 C.
	b. Defective Preamp.	b. Check Preamp., paragraph 4-48.
	c. Defective No Fade.	c. Check No Fade, paragraph 4-57.
9. Recorder does not run.	a. Defective fuse F2.	a. Replace if necessary. If fuse opens when power is applied, check for short circuit in Recorder power supply.
	b. Defective system power supply.	b. Perform Power Supply Tests, paragraph 4-45 A.
	c. Defective paper drive motor.	c. Replace paper drive motor. Refer to paragraph 4-15.
10. Recorder motor runs but no trace on paper.	a. Stylus bent or maladjusted.	a. Perform Recorder stylus replacement or adjustment in paragraph 4-16 & 4-55.
	b. Stylus HEAT set too low.	b. Same as a.
	c. Defective heat circuit.	c. Check stylus heat circuit.
11. Recorder runs but stylus stays deflected to one side or does not respond and stays at center.	a. Defective pen drive motor.	a. Replace recorder, Refer to paragraph 4-15.
	b. Defective drive circuit.	b. Check drive transistors.
12. No deflection when CAL switch depressed but normal trace on CRT and signal when applied to patient cable.	a. Defective switch.	a. Replace switch.
	b. Defective voltage divider in CAL circuit.	b. Check voltage divider.

TABLE 4-2 (Continued)

ECG MONITOR/RECORDER UNIT TROUBLESHOOTING

MALFUNCTION	POSSIBLE CAUSE	CORRECTIVE ACTION
13. No signal on CRT or Recorder when signal is applied or CAL switch is depressed. Normal trace on CRT.	a. Defective pre-amplifier circuit. b. Defective no-fade circuit.	a. Perform preamplifier checks, paragraph 4-48. b. Perform digital circuit checks, paragraph 4-57.
14. ECG signal does not hold when FREEZE pushbutton is depressed.	a. Defective no-fade circuit. b. Defective FREEZE switch.	a. Check U6-A and U4-A on No-Fade PCB. b. Replace switch.
15. No systole sound.	a. Defective SYST VOL pot. b. Defective operational amplifier or transistor. c. Defective sonalert.	a. Replace SYST VOL pot. b. Check components in systole sound circuit, on No Fade PCB. c. Replace sonalert. Refer to paragraph 4-15.(Mounted on Recorder).
16. Incorrect ECG display. Information is lost or distorted on CRT display.	No-fade circuit.	Perform digital circuit checkout paragraph 4-57.
17. Incorrect ECG display in presence of transmitting equipment.	Loss of RFI Shielding.	Open unit and inspect conductive coating. If scratches or chips are apparent contact Physio-Control Service Department.

4-44. Control and Test Equipment Setup.

1. If installed, remove Battery/Pak.
2. Split unit upper and lower cases according to paragraph 4-8.
3. Set controls to positions shown in Table 4-3.
4. Connect DC Supply (1) and Digital Multimeter (2) to Battery/Pak input terminals.

TABLE 4-3

ECG MONITOR/RECORDER UNIT INITIAL CONTROL SETTINGS	
CONTROL	POSITION
RECORD	OFF
POWER	PWR OFF
ECG SIZE	CCW
HEAT	CCW
SYST VOL	CCW

CAUTION

Replacing a blown fuse will often restore the unit to service. Always measure power supply voltages after replacing the fuse.

4-45. Power Supply Tests. After completing the initial setup of paragraph 4-44, proceed as follows: Refer to Figure 3-9 for a schematic of the power supply. Test equipment is referenced ( ) to Table 4-1.

A. Minimum Current Test.

1. Locate and remove fuse F2. (Red fuse holder.)
2. Set the DC Ammeter (Table 4-1, Item 3) to read more than one ampere full scale. Connect DC Ammeter between fuse holder terminals of Main Power fuse (F2).
3. Adjust DC Power Supply (1) to 12.5V using Digital Multimeter (2) as a voltage monitor.
4. All controls should be in the off or minimum position.
5. Turn the Pwr/Mode select switch, S1, to PADDLES or any patient cable lead position and verify that power is applied to ECG Monitor/Recorder.

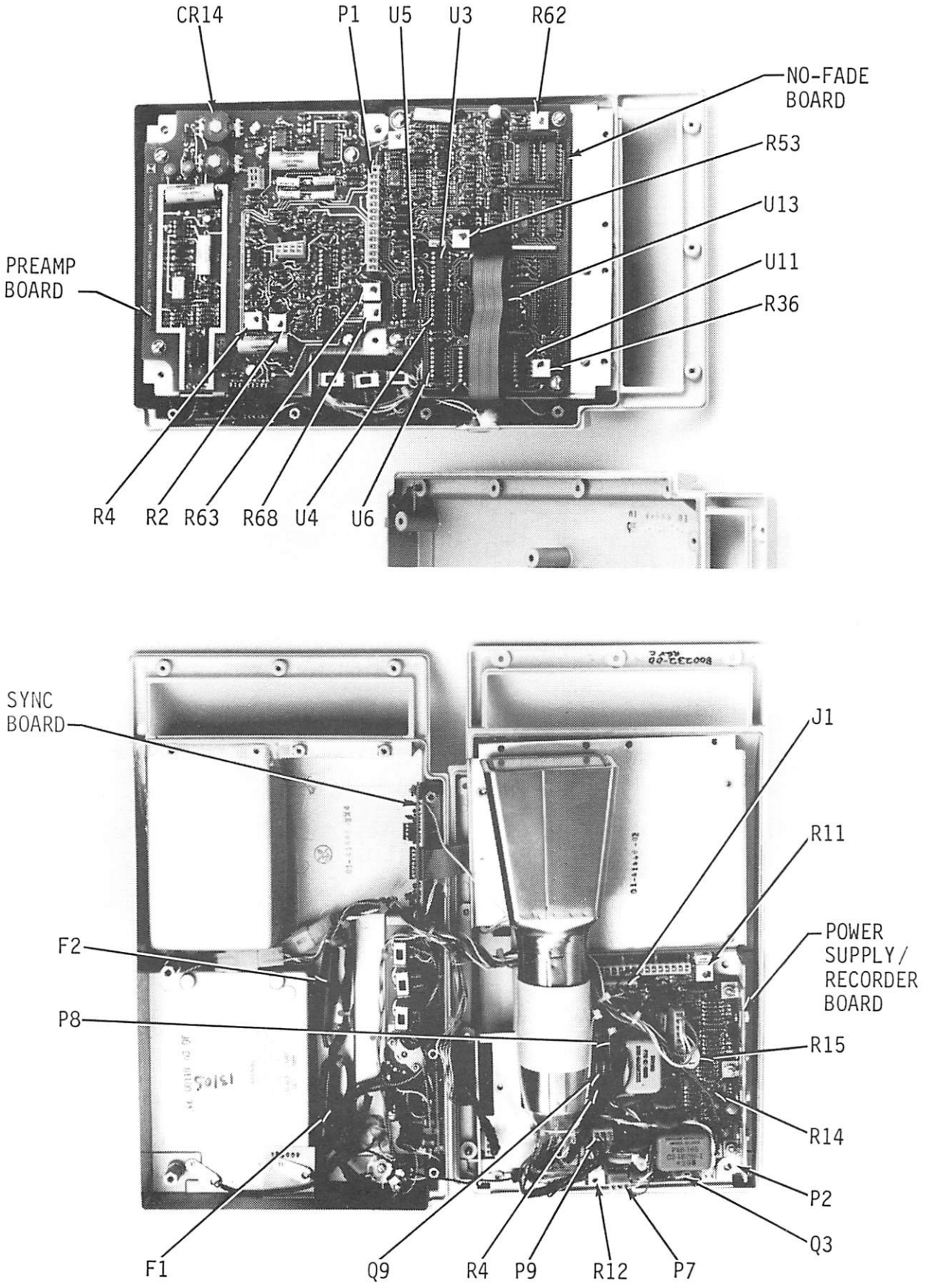


FIGURE 4-9. ECG MONITOR/RECORDER UNIT COMPONENT IDENTIFICATION

4-45. Power Supply Tests. (Continued)

A. Minimum Current Test. (Continued)

6. Verify that the DC Ammeter indicates less than 490mA. If the current exceeds 490mA, an attempt must be made to isolate and correct the cause of the abnormal current drain. If cause is not identified, contact Physio-Control Service Department for instructions.

7. Turn Pwr/Mode select switch to PWR OFF.

8. Disconnect DC Ammeter from F2 fuse holder terminals and replace fuse.

B. Maximum Current Test.

1. Locate and remove fuse F1. (Black fuse holder.)

2. Set DC Ammeter to the two amp scale and connect it between the F1 fuse holder terminals.

3. Connect Function Generator (Table 4-1, Item 5) to patient cable connector with Preamp Input fixture. Adjust Function Generator for a 10Hz, 1V p-p sine wave output.

4. Rotate ECG SIZE, HEAT and SYST VOL to maximum (fully clockwise).

5. Turn Pwr/Mode select switch to II position. Depress RECORD power switch and verify paper drive motor runs.

6. Check that DC Ammeter indicates no more than 1.2A. (Current should rise to 1.9A, then fall to 1.2A.)

7. Turn Pwr/Mode select switch to PWR OFF.

8. Disconnect DC Ammeter from F1 fuse holder terminals and replace fuse.

C. Main Power Oscillator Verification.

1. Adjust DC Power Supply to 12.5V.

2. Connect the X10 probe of Oscilloscope (Table 4-1, Item 4) to Q3 collector on Power Supply and Recorder PCB. Set Oscilloscope vertical sensitivity to 5V/div.

3. Turn Pwr/Mode select (ECG LEAD) switch to II position.

4. The waveform on Oscilloscope should closely resemble the one in Figure 4-10. The specific values are 16V p-p, 12KHz ± 20% and an overshoot of less than 20%.

4-45. Power Supply Tests. (Continued)

C. Main Power Oscillator Verification. (Continued)

5. Move Oscilloscope probe from collector of Q3 to collector of Q4 and verify that it has the same waveform as Collector of Q3.

6. Turn the Pwr/Mode select to PWR OFF position and remove the probe from collector of Q4.

D. Recorder Power Oscillator Verification.

1. Adjust DC Power Supply to 12.5V.

2. Connect X10 probe of the Oscilloscope to collector of Q4 on Power Supply and Recorder PCB. Set Oscilloscope vertical sensitivity to 5V/div.

3. Turn Pwr/Mode select (ECG LEAD) switch to II and depress RECORD pushbutton.

4. The waveform on Oscilloscope should closely resemble the one in Figure 4-11.

5. Move the X10 oscilloscope probe from collector of Q3 to collector of Q4 and verify that it has the same waveform as collector of Q3.

6. Turn Pwr/Mode select to PWR OFF position and remove the probe from collector of Q4.

E. +12V Regulator Test.

1. Connect Digital Multimeter (Table 4-1, Item 2) between J1-8(+) and J1-11 (power ground). This is the output of ECG Monitor/Recorder 12V supply.

2. Turn Pwr/Mode select switch, S1, to PADDLES and verify power is applied to system.

3. Vary DC Power Supply output from 11Vdc to 15Vdc and verify that the Digital Multimeter, connected to the ECG Monitor/Recorder 12V Supply, indication does not change by more than ±1%.

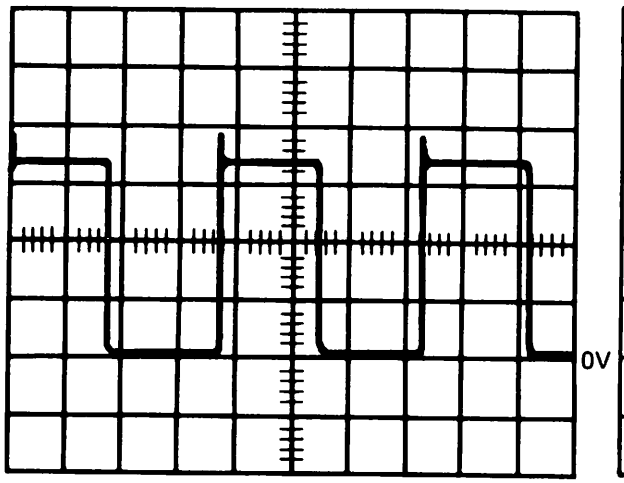
4. Re-adjust DC Power Supply to 12.5 Vdc.

F. ECG Monitor/Recorder Unit Power Supply Voltage Checks.

1. Connect Digital Multimeter (2) to each of the test points indicated in Table 4-4 and check that individual power supplies are within the limits given in table.

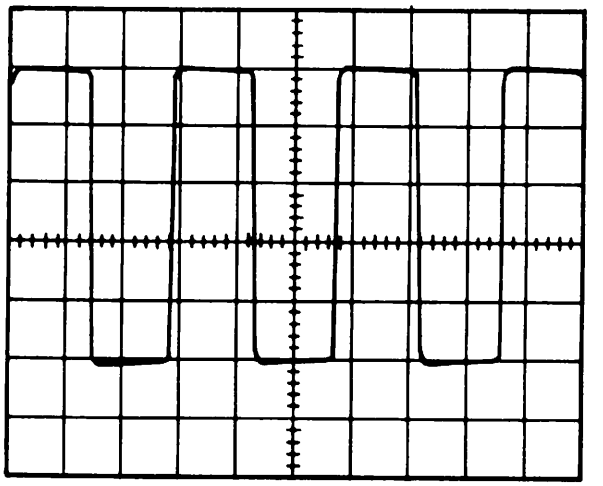
NOTE: Cathode, Grid and Focus Test points are -1300V. Use a high voltage probe to measure those voltages.

4-45. Power Supply Tests. (Continued)



5V/div
20µs/div

FIGURE 4-10. MAIN POWER SUPPLY WAVEFORM



5V/div
20µs/div

FIGURE 4-11. RECORDER POWER WAVEFORM

4-45. Power Supply Tests. (Continued)

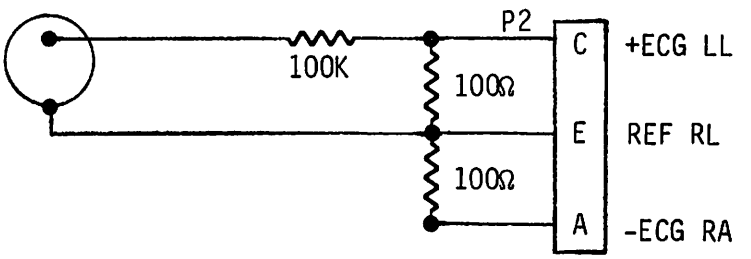
TABLE 4-4

ECG MONITOR/RECORDER UNIT POWER SUPPLY VOLTAGE CHECKS

LOCATION		NOMINAL VOLTAGE (Vdc)	LIMITS (Vdc)
+	COMMON		
J1-6	J1-11 (PWR GND)	+5	+4.75 to +5.25
J1-7	J1-11	-5	-4.75 to -5.25
J1-8	J1-11	+12	+11.40 to +12.60
J1-9	J1-11	-12	-11.40 to -12.60
J1-15	J1-11	+120	115 to 125
P8-1	J1-11	ASTIG	Variable from 0 to 120
P9-3	J-11 (GRID)	-1300	-1200 to -1400
P9-2	J1-11 (CATHODE)	-1275	Variable from approximately -1160 to -1392
P9-1	J1-11 (FOCUS)	-1113	Variable from approximately -986 to -1240
P2-1	P2-2 (CRT FILLAMENT)	6.3VAC	6.0 to 6.6
P7-1	P7-3	ROTATING COIL	Variable from 0 to 8
CR14-Cathode (Preamp PCB)	P10-1 (ISO. GRD, Preamp PCB)	+12 (ISOLATED)	11.40 to 12.60
CR15-Anode (Preamp PCB)	P10-1 (ISO. GRD, Preamp PCB)	-12 (ISOLATED)	-11.4 to -12.60

4-45. Power Supply Tests. (Continued)

NOTE: This fixture may be constructed from the parts list and schematic provided below.



QUANTITY	DESCRIPTION	MFG. P/N	PCC P/N
1	BNC Male Plug	KING # KC-59-92	90-09010
1	Circular 6 pin	Amphenol Clamp M5 3057-64 Connector 97-3106A145-6P Boot	 02-20344 02-20343
1	Cable RG-174/4	Belden 8216	
 2 1	Resistors 100Ω 1% 1/8W 100KΩ 1% 1/8W		 200054-097 200054-384

FIGURE 4-12. PREAMP INPUT FIXTURE

4-46. Low Battery Check. After completing the initial setup and power supply tests, proceed as follows to test the low battery alarm circuit. Refer to Figure 3-10 for a schematic of the Low Battery Level Circuit. Test equipment is referenced ( ) to Table 4-1.

A. Adjust the external DC Power Supply (Table 4-1, Item 1) to 12.5V using Digital Multimeter (Table 4-1, Item 2) as a voltage monitor.

B. With all controls set to a minimum or off, rotate Pwr/Mode select, S1, to PADDLES. Verify power is applied to ECG Monitor/Recorder.

C. Gradually reduce the DC Power Supply voltage in 0.1V increments until Low Battery indicator begins to flash.

D. Verify that the supply voltage at this point is between 10.0 to 10.25Vdc. If necessary adjust R24 on No-Fade PCB Assy. See Figure 5-5 for location.

4-47. CRT Tests and Adjustments.

A. Horizontal Sweep.

1. Connect Patient Cable to patient cable connector and short Red and White leads together. Turn ECG SIZE control to minimum (fully CCW).

2. Set Pwr/Mode select switch to II position and verify a trace appears on CRT.

3. Connect Oscilloscope (4) to P1-2 on Preamp PCB.

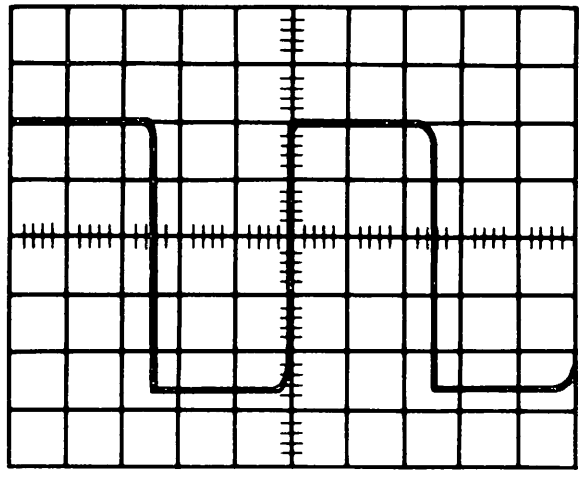
4. Adjust R36 (horizontal sweep) on No Fade PCB to obtain a 5v p-p square wave with a period of 10ms on the Oscilloscope. The square wave should closely resemble that of Figure 4-13.

B. Horizontal Skew and Centering.

1. Alternately adjust R53 (vertical position) on No-Fade PCB and R12 (horizontal tilt) on power supply until a parallel trace that is 1.125" (1 1/8") from the top of the chassis is obtained. If R12 (horizontal tilt) will not level the trace, reverse P7 on Power Supply PCB.

C. Horizontal Centering.

1. Adjust R68 (horizontal positioning) on Preamp PCB, so trace is centered horizontally.



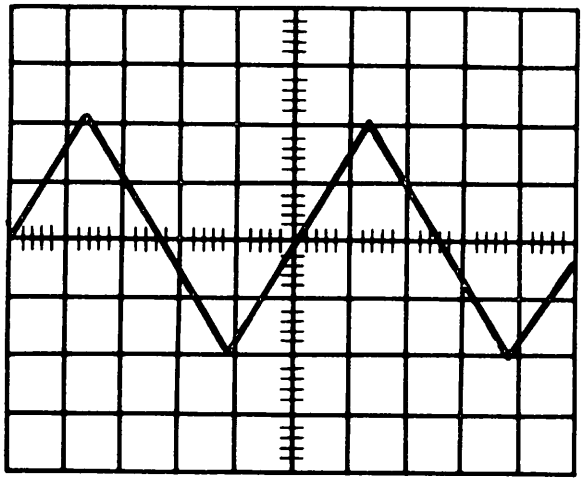
1V/div
2ms/div

FIGURE 4-13. HORIZONTAL SWEEP WAVEFORM

4-47. CRT Tests and Adjustments. (Continued)

If the waveform in Figure 4-13 cannot be obtained, check these points for waveforms in Figure 4-14 and 4-15.

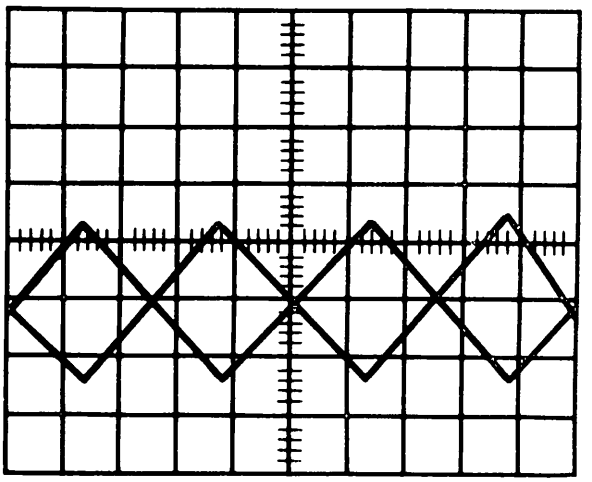
ECG Preamp - U7 Pin 6



1V/div
2ms/div

FIGURE 4-14. HORIZONTAL SWEEP GENERATOR WAVEFORM

Test Oscilloscope
Ch 1 - J8 Pin 3, Ch 2 - J8 Pin 4



10V/div
2ms/div

FIGURE 4-15. HORIZONTAL DEFLECTION AMPLIFIER WAVEFORMS

D. Horizontal Sweep.

1. Connect Function Generator (Table 4-1, Item 5) to patient cable input with Preamp Input Fixture (Table 4-1, Item 13).

2. Turn on Function Generator and adjust it for a 1Hz, 1V p-p, square wave output.

3. Depress FREEZE button so that two peaks of the square wave are centered in the screen.

4. Measure the distance from peak to peak and adjust R63 so there is 25 mm±1mm between the peaks. The ends of the trace should not be visable on the screen. Readjustment of R68 (horizontal position) may be necessary.

E. Focus and Astigmatism.

1. Change the frequency of Function Generator to 10Hz.

2. Alternately adjust R4 (Focus) and R14 (astigmatism) so the clearest trace appears in center of the screen.

4-47. CRT Tests and Adjustments. (Continued)

F. Intensity. (Measurements must be made without the green faceplate.)

1. Increase the frequency of Function Generator to 20Hz.

2. Adjust ECG size for a 2cm vertical deflection on the CRT.

3. Turn Pwr/Mode select to PWR OFF position. Place Digital Photometer on the face of the CRT and note the reading caused by ambient light conditions in the test area.

4. Turn Pwr/Mode select to LEAD II. Move Photometer up and down on the face of the CRT. The maximum reading observed minus the ambient light measurement must be greator than 5.0 ft Lamberts. If the measurement is below 5.0 ft Lamberts adjust R3 (intensity) on Power Supply PCB.

CAUTION

Do not adjust the intensity over 6.5 ft Lamberts as permanent damage to CRT may result. If the intensity must be changed, readjust the focus and astigmatism as described in steps 1 and 2 of Focus and Astigmatism.

4-48. Preamplifier Gain and Frequency Response.

A. Preamp Gain Adjustment.

1. Connect Function Generator to patient cable connector with Preamp Input Fixture and adjust it for an output of 10Hz, 1V p-p sine wave.

2. Set Pwr/Mode select (ECG LEAD) switch to II.

3. Connect Oscilloscope (Table 4-1, Item 4) to ECG OUT; this point is accessible at J11 pin 3 on the Pre-Amp PCB or tip connection of ECG OUT jack.

4. Observe Oscilloscope (4) display and verify ECG OUT signal is 1V p-p, 10Hz sine wave ±10% and is clean and undistorted. (1mV ± 10% for units with 1mV output option). If necessary adjust R4 (gain) on Preamp PCB for proper amplitude.

B. Minimum and Maximum ECG Gain.

1. Adjust ECG SIZE to maximum (CW). Use the same set-up as described in Preamp Gain Adjust procedure.

2. Observe CRT display and verify that a minimum of 80% of the screen is filled.

4-48. Preamplifier Gain and Frequency Response. (Continued)

B. Minimum and Maximum ECG Gain. (Continued)

3. Adjust ECG SIZE to minimum and increase Function Generator output to 10V. All parts of the sine wave should be visible on the screen. Change Function Generator to 2Hz and verify that no distortion or clipping occurs.

C. ECG/Voice Recorder Preamp Gain Check. (U10a)

1. Connect Function Generator to pins 1 and 3 of P12 (the slide connector for ECG/Voice Recorder).

2. Adjust generator for an output of 10Hz, 1V p-p sine wave.

3. Turn Pwr/Mode select switch to II.

4. Connect Oscilloscope to 1V ECG OUT, pin 2 on P12.

5. Observe Oscilloscope display and check that ECG signal is about 1.3Vdc p-p, 10Hz sine wave and is clean and undistorted.

DO NOT READJUST R4 FROM THE SETTING MADE IN PARAGRAPH A.4.

6. Remove Oscilloscope from pin 2 on P12, and connect it to tip of jack connector on front panel, ECG OUT/1V.

7. Observe Oscilloscope display and check that ECG signal is as given in para. C.5.

8. Disconnect all test equipment from monitor unit.

D. ECG/Voice Recorder Play Enable Circuit. (U10b)

1. Connect test equipment as described in paragraph A.1 through A.3.

2. Observe sine wave on monitor CRT.

3. Apply +5Vdc to pin 4 of P12, (slide connector for ECG Voice Recorder).

4. Check that sine wave has disappeared and straight line is displayed on CRT.

5. Remove signal from patient cable connector and connect it at P12, pins 1 and 2.

6. Check that sine wave is again displayed on monitor CRT, with +5Vdc still applied to pin 4 of P12.

7. Remove all test equipment and +5Vdc from the monitor.

4-48. Preamplifier Gain and Frequency Response. (Continued)

E. CRT Frequency Response.

1. Connect Preamp Input Fixture, Function Generator, and Oscilloscope in parallel using the BNC T connector.

2. Adjust Function Generator for a 1V p-p, 10Hz sine wave output using the Oscilloscope as a voltage monitor.

3. Set Pwr/Mode select switch to LEAD II.

4. Adjust ECG SIZE for a 3cm peak to peak deflection on Monitor CRT.

5. Vary frequency of Function Generator from .5 to 40Hz (.5 to 35Hz on 50Hz units) while maintaining a constant 1V output, note frequency where maximum deflection occurs.

6. Set Function Generator to frequency of maximum deflection and adjust ECG SIZE for 2.5cm p-p.

7. Vary frequency of Function Generator from .5 to 40Hz (.5 to 35Hz on 50Hz units). Note frequency of minimum deflection. The minimum deflection cannot be less than 1.75cm (70% of maximum amplitude).

4-49. Recorder Gain and Frequency Response.

A. Connect Function Generator, Oscilloscope and Preamp Input Fixture in parallel using the BNC "T" connector.

B. Adjust Function Generator output for 1V p-p, 10Hz sine wave and turn it off.

C. Turn Pwr/Mode select switch to LEAD II position and set ECG control for 1cm deflection on CRT.

D. Turn Recorder Compensation on Power Supply PCB, R50, to maximum (fully CW).

E. Push RECORD switch to on and verify trace is centered on the paper. If trace is not centered, adjust R62 (Recorder Offset Adjust) on No-Fade PCB. Set stylus HEAT to maximum (CW).

F. Turn on Function Generator and observe sine wave amplitude on recorder. It must be 10mm ± 1mm, if not adjust R11 on Power Supply PCB. (See Figure 4-1 for location.)

G. Adjust ECG SIZE so 3cm of deflection is displayed on CRT. Adjust R50 Recorder Compensation on Power Supply PCB so recorder trace does not exceed 2.8cm p-p.

4-49. Recorder Gain and Frequency Response. (Continued)

H. Observe the output of Function Generator with Oscilloscope and verify that it is a 1V p-p sine wave. Maintain this output voltage level for the duration of this test.

I. Decrease ECG SIZE to 1cm on recorder.

J. Vary frequency of Function Generator from .5Hz to 40Hz (35Hz on 50Hz units). Verify that amplitude of the recorder does not drop below 7mm, p-p.

4-50. Notch Filter.

A. Connect Function Generator to patient cable connector via Preamp Input Fixture and adjust it for an output of 1V p-p, 60Hz (50Hz for 50Hz units) sine wave.

B. Connect Oscilloscope to ECG OUT jack.

C. Set Pwr/Mode select switch to LEAD II.

D. Verify ECG OUT signal is less than 10mV p-p.

4-51. Preamp Intrinsic Noise Test.

A. Connect Function Generator to patient cable input using Preamp Test Fixture and adjust it for an ouput of 1mV p-p, 10Hz sine wave.

B. Set Pwr/Mode select switch to LEAD II.

C. Adjust ECG SIZE for 2cm of deflection on CRT.

D. Replace Preamp Test Fixture with Patient Cable and connect two 25K resistors to RA, LA and LL leads as shown in Figure 4-16.

E. Observe displayed noise on CRT in all lead positions. The peak to peak noise must be less than 1mm.

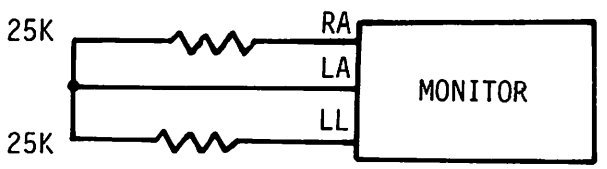


FIGURE 4-16. PREAMP INTRINSIC NOISE TEST SET-UP

4-52. Common Mode Rejection.

A. Connect Function Generator to patient cable connector with Preamp Input Fixture.

B. Adjust Function Generator for an output of 1mV p-p, 40Hz sine wave.

C. Set Pwr/Mode select switch to LEAD II position. Adjust ECG SIZE control for a 2cm deflection on CRT.

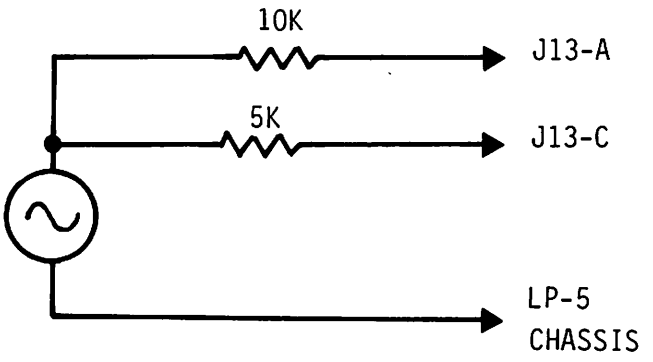


FIGURE 4-17. COMMON MODE REJECTION TEST SET-UP

D. Remove Preamp Input Fixture and reconnect Function Generator to patient cable connector as shown in Figure 4-17.

E. Increase Function Generator output voltage until 2cm of deflection is again displayed on CRT.

F. Measure Function Generator output voltage. It must be over 10V p-p.

4-53. Quick Restore.

A. Set ECG SIZE for maximum (fully CW).

B. Adjust DC Power Supply for an output of 1 Vdc and then turn it off.

C. Attach Red and White leads of Patient Cable to the output of DC Power Supply.

D. Turn Pwr/Mode select switch to LEAD II position and allow CRT trace to stabilize in center of screen.

E. Turn on DC Power Supply and observe CRT trace. The trace must return to within ± 1cm of center of screen within 8 seconds of application of dc offset.

F. Turn off DC Power Supply and reverse the leads. Repeat steps D and E.

4-54. 1mV Cal.

A. Connect Function Generator ouput to patient cable connector with Preamp Input Fixture.

B. Adjust Function Generator output for 1V p-p, 1Hz square wave.

C. Set Pwr/Mode select switch to LEAD II position and push RECORD pushbutton.

D. Adjust ECG SIZE for a 1cm deflection on recorder trace.

E. Turn off Function Generator. Push CAL pushbutton and observe recorder waveform. The calibration waveform height must be 1cm. If not, adjust R2 (1mV adjust) on Preamp PCB until a 1cm pulse is obtained. (See Figure 5-4 for location, page 5-17.)

4-55. Recorder Stylus Tests and Adjustments.

A. Set Pwr/Mode select switch to Lead II position.

B. Connect Patient Cable to patient cable connector and short circuit Red and White leads together. Verify CRT trace is clean and flat.

C. Turn on Recorder and adjust stylus heat control (HEAT) for satisfactory trace intensity.

D. Adjust ECG SIZE control to obtain a 1cm CAL pulse on recorder.

E. Compare CAL pulse on recorder display to waveforms shown in Figure 4-18 and if CAL pulse is not acceptable, proceed to the next step for adjustment procedures.

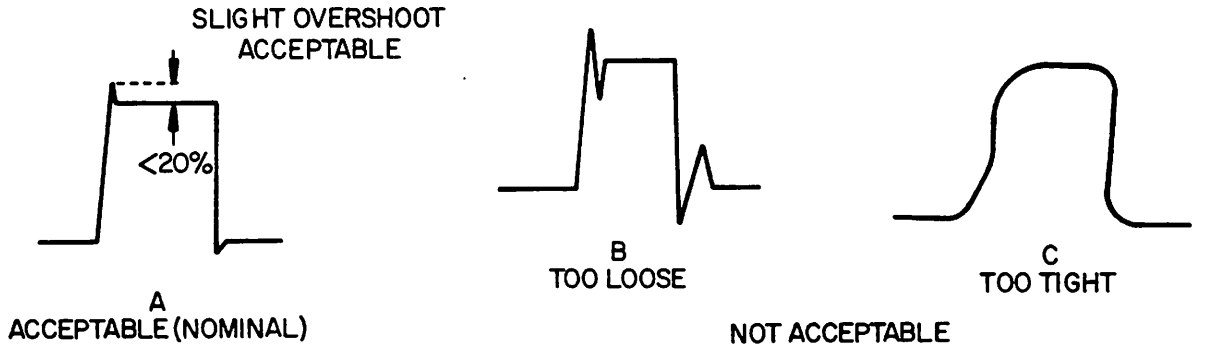


FIGURE 4-18. RECORDER WAVEFORMS

F. Use the allen wrench provided in the stylus replacement kit to change the stylus pressure. Increase the stylus pressure by turning the adjustment screw counterclockwise. Repeat steps E and F until an acceptable waveform is obtained.

4-55. Recorder Stylus Tests and Adjustments. (Continued)

G. When an acceptable waveform is obtained, perform paragraph 4-49 Recorder Gain and Frequency Response.

4-56. Paper Drive Motor Speed.

A. Connect Function Generator ouput to patient cable connector with Preamp Input Fixture.

B. Adjust Function Generator output for 1V p-p, 1Hz square wave.

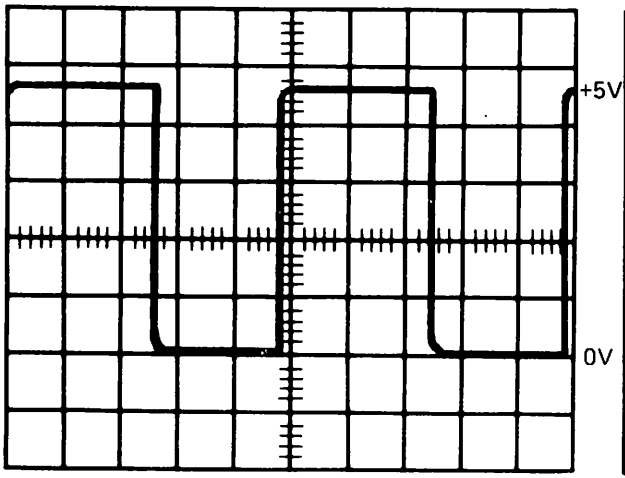
C. Turn Pwr/Mode select switch to LEAD II position and push RECORD pushbutton.

D. Adjust ECG SIZE for a 1cm pulse height on recorder trace.

E. Measure the length of 6 cycles on the recorder paper. It must be 150 mm ± 3mm; if not, adjust R15 on Power Supply PCB. (See Figure 4-9 for location.)

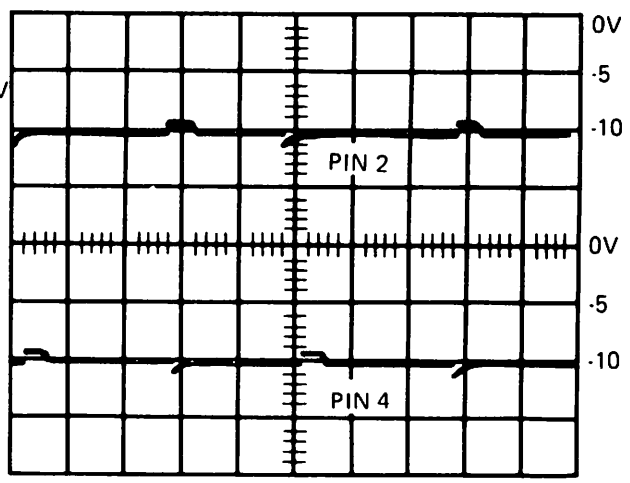
4-57. Digital Circuitry Waveforms. There are no adjustments to the digital circuitry, on the No-Fade PCB, except the horizontal sweep covered in paragraph 4-47, step A. The following steps provide references to figures providing typical waveforms at key points. Using Oscilloscope, (4) observe waveforms at points listed. Refer to Figure 4-9 for help in locating test points. Test equipment is referenced ( ) to Table 4-1.

A. Clock Pulse at U11-B-12. Refer to Figure 4-19. The master clock will be available whenever power is applied to the unit. The waveform should be symmetrical and approximately 5V p-p. The frequency will be approximately 100KHz. If not present, check U11-A and U11-B.



1V/div
2μ/div

FIGURE 4-19. CLOCK PULSE AT U11-B-12



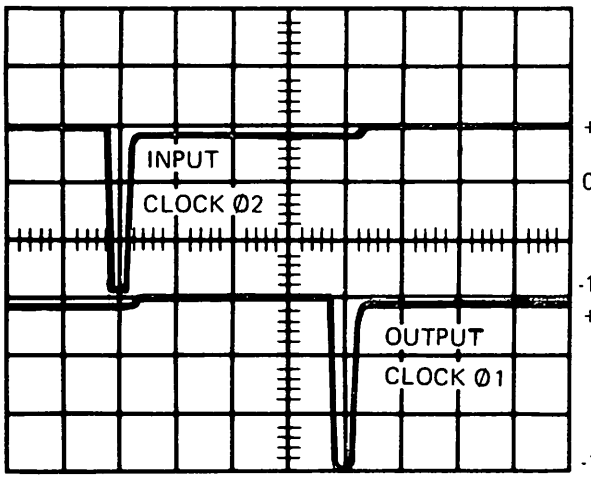
5V/div
2μ/div

FIGURE 4-20. CLOCK PULSE AT U13-2 and -4

4-57. Digital Circuitry Waveforms. (Continued)

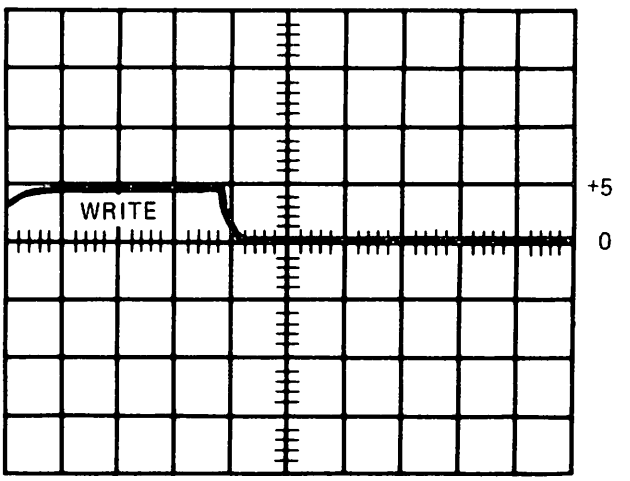
B. Clock Pulse at U13-2 and -4. Refer to Figure 4-20. The clock pulses at the memory clock driver will be available whenever power is applied to the unit and the master oscillator is on. At a -10V level they are 180° out of phase and approximately 1V p-p. If not present, check 4 stages of U22, U11-C and U11-D and master oscillator.

C. Shift Register Clock Pulses at U13-7 and -5. Refer to Figure 4-21. The shift register pulses will be available whenever power is applied to the unit and the master oscillator is on. The pulses are typically 15V p-p with an approximate duration of 0.5ms. If not present check U13, buffers U22, Schmitt triggers U11-C and -D, and master oscillator.



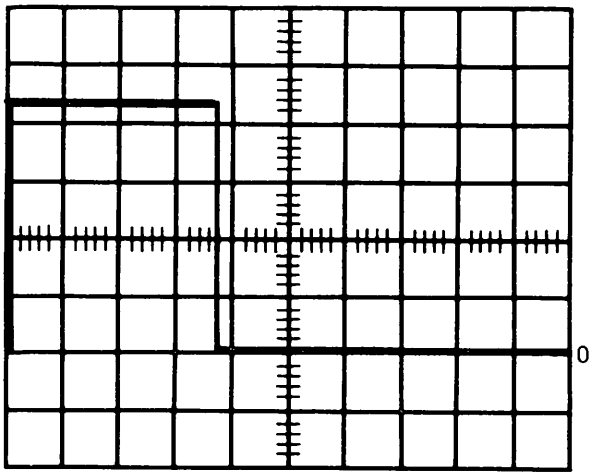
5V/div
1µ/div

FIGURE 4-21. SHIFT REGISTER PULSE AT U13-7 and -5



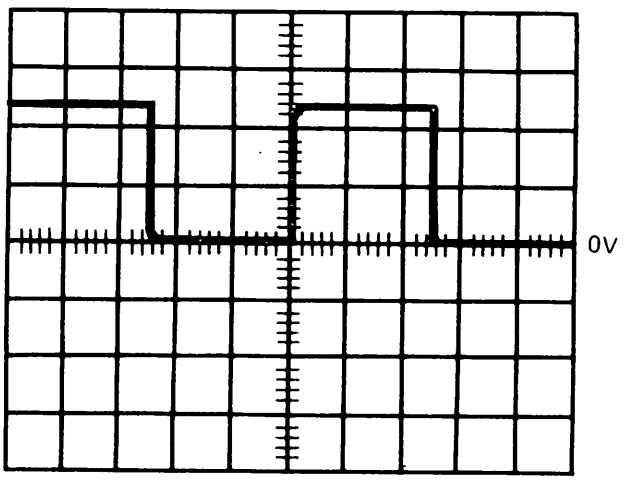
5V/div
1µ/div

FIGURE 4-22. WRITE/RECIRCULATE PULSE AT U3-A-5



1V/div
5µ/div

FIGURE 4-23. A/D RESET PULSE AT U3-B-13



2V/div
2µ/div

FIGURE 4-24. RETRACE BLANKING PULSE AT U4-A-13

4-57. Digital Circuitry Waveforms. (Continued)

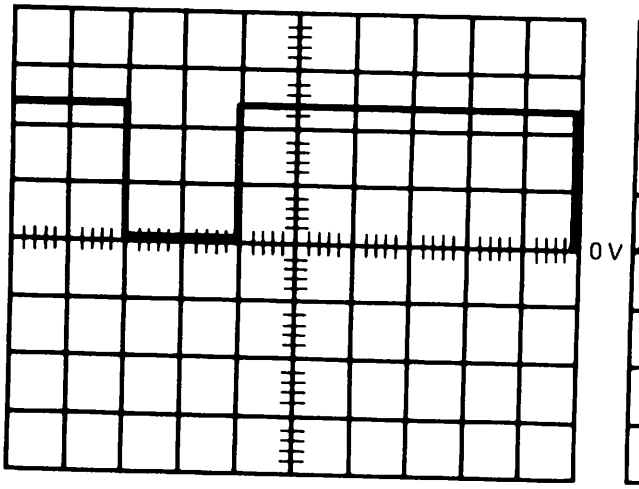
D. Write Recirculate Pulse at U3-5. Refer to Figure 4-22. The write recirculate pulse will typically be +5V in amplitude and have a duration of approximately 4ms. If not present, check U6-A, U3-A, U4-A and master oscillator.

E. A/D Reset Pulse U3-B-13. Refer to Figure 4-23. The A/D reset pulse will typically be +4V in amplitude and have a duration of approximately 18-20ms. If not present, check U3-B, U6-A through U6C and U4-B.

F. Retrace Blanking at U4-A-13. Refer to Figure 4-24. The retrace blanking pulse will typically be 5V p-p and have an approximate duration of 4ms. If not present, check U4-A, U3-A, U7, U6-A.

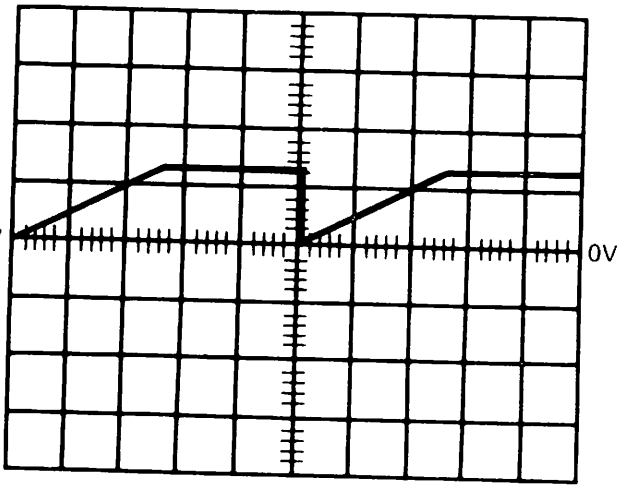
G. A/D Compare Latch at U6-4. Refer to Figure 4-25. The A/D compare latch will typically be 4V in amplitude and have a duration of approximately 10ms. If not present, check U6-A to U6-C, &5, U3-B, U4-B and master oscillator.

H. Stairstep at U5-2. Refer to Figure 4-26. If not present, check output of ladder R76, U10, U5 and U6-A to U6-C.



2V/div
5μ/div

FIGURE 4-25. A/D COMPARE LATCH AT U6-4



2V/div
1μ/div

FIGURE 4-26. STAIRSTEP AT U5-2

4-58. DC DEFIBRILLATOR UNIT

Procedures in this section are divided into the following topics: Functional Checks, Component Identification, Troubleshooting, and Test and Calibration.

4-59. Functional Checks.

A. Initial Control and Test Equipment Setup.

1. Set the POWER control to OFF on the STERNUM paddle.
2. Set the ENERGY JOULES to 40.
3. Remove the Battery Pak.
4. Connect the DC Power Supply (Table 4-1, Item 1) and Digital Multimeter (Table 4-1, Item 2) to the Battery/Pak terminals on the Defibrillator observing proper polarity.
5. Set the DC Power Supply to 12.6V using the Digital Multimeter.
6. Secure the Paddles to the Energy Meter (Table 4-1, Item 6) pads.

WARNING

HAZARDOUS VOLTAGE (4300V) IS PRESENT ACROSS THE PADDLES WHEN DISCHARGE OCCURS, OR COULD BE PRESENT DURING THE CHARGE CYCLE. IF THERE IS A MALFUNCTION IN THE DEFIBRILLATOR CIRCUITS, SECURE THE PADDLES TO THE ENERGY TEST METER FOR ALL CHARGE AND DISCHARGE TESTS, EXCEPT FOR SPECIAL REQUIREMENTS.

7. Press POWER Pushbutton, S3, on the STERNUM Paddle and check that green POWER indicator lights.
8. Press the POWER pushbutton again and check that the green indicator light goes out.

B. Current Drain. After completing test setup as described in paragraph A., proceed as follows:

CAUTION

Replacing a blown fuse will often restore the unit to service. Always measure power supply voltages after replacing the blown fuse.

1. Adjust DC Power Supply (Table 4-1, Item 1) to 11.4V (minimum operating voltage) using Digital Multimeter (Table 4-1, Item 2) to check voltage.

4-59. Functional Checks. (Continued)

B. Current Drain. (Continued)

2. Set Digital Multimeter to 10A dc scale. Connect it in series with the positive lead of DC Power Supply. (Use not more than three feet of number 19 wire in each lead.)

3. Press POWER Pushbutton, S3, on STERNUM paddle and check that green POWER indicator lights.

4. Set ENERGY JOULES Selector, S4, to maximum energy.

5. Press and release CHARGE Pushbutton, S6, on APEX paddle. Observe current drain on Digital Multimeter. Current increases during the charge cycle until full charge is reached. Then, it falls back to minimum current.

6. Check that current does not exceed 10A. Charge time should be between 10sec and 12sec.

7. Discharge Energy Meter (Table 4-1, Item 6) by pressing both red Discharge Pushbuttons, S2 and S5, simultaneously.

8. Press POWER Pushbutton, S3, and check that green POWER indicator goes off.

C. Low Battery Level Check. After completing the initial setup of paragraph A., proceed as follows:

1. Gradually reduce DC Power Supply voltage in 0.1V increments until POWER indicator begins to flash.

2. Check that dc Supply voltage at this point is between 10.0 to 10.3V. (Low volt alarm limit.)

D. Charge and Automatic Recharge Circuitry.

1. Set ENERGY JOULES Selector, S4, on APEX Paddle to 360 joules.

2. Start the Stopwatch (Table 4-1, Item 7) and press CHARGE Pushbutton simultaneously.

3. Check that amber CHARGE indicator flashes while charging.

4. Stop the Stopwatch when CHARGE indicator shows a steady light.

5. Check that elapsed time is 11.25 and 12.5 seconds and that charge current is less than 10A.

6. Depress red Discharge Pushbuttons, S2 and S5, and check that energy is transferred to Energy Meter (Table 4-1, Item 6).

4-59. Functional Checks. (Continued)

D. Charge and Automatic Recharge Circuitry. (Continued)

7. Press the CHARGE pushbutton once more, and re-start the Stopwatch when the amber CHARGE indicator stops flashing and shows a steady light.

8. Stop the Stopwatch when the CHARGE indicator start to flash again.

9. The indicator should start to flash again about 30 seconds after indicating a steady charge condition.

   This shows that the Automatic Recharge circuit is working properly, and that the charge has leaked down to 90% (or less) of the selected charge (joules).

E. Selected Energy Test. After completing initial test setup of paragraph A., proceed as follows:

1. Set the ENERGY JOULES Selector for 50 joules.

2. Press the CHARGE Pushbutton, then immediately press both the red Discharge Pushbuttons and hold them down until unit discharges.

3. Check that the Energy Meter indicates between 4.7 and 53 joules.

4. Set ENERGY JOULES Selector for 360 joules.

5. Repeat steps 1 through 2.

6. Check that the ENERGY METER reads between 338 and 332 joules. Note the reading for use in the bleed down test.

7. Set external DC Power Supply (Table 4-1, Item 1) to 10V output.

8. Repeat steps 1 through 6.

F. Bleed Down. After completing the Selected Energy Check described in paragraph E., proceed as follows:

1. Set ENERGY JOULES Selector, S4, to maximum energy. Press CHARGE pushbutton, and allow the unit to charge.

2. Start the Stopwatch when the CHARGE indicator stops flashing.

3. After 15 seconds, discharge the unit and check the Energy Meter reading.

4. The reading should be at least 90% of the energy measurement recorded in paragraph E, Step 6.

4-59. Functional Checks. (Continued)

G. Internal Discharge "Dump". After completing Initial Setup of paragraph A., proceed as follows:

1. Set ENERGY JOULES Selector S4 to maximum energy.

2. Press CHARGE Pushbutton S6.

3. When the CHARGE Indicator becomes steady amber, turn off unit by pressing POWER Pushbutton S3.

4. Unit should discharge internally (dump). There should be no reading on the Energy Meter.

5. Depress POWER Pushbutton S3. Wait 15 seconds and then depress CHARGE Pushbutton S6.

6. Verify that the amber CHARGE Indicator flashes for at least 6 seconds before becoming steady. If the indicator only flashes for 4 seconds or less, the dump circuit is faulty.

7. Remove paddles from Energy Meter (6). Hold paddles approximately 1 foot apart and depress Discharge S2 and S5 Pushbuttons.

8. Verify that the amber CHARGE Indicator goes out indicating that the charge was discharged internally, "dumped".

9. Fasten paddles on Energy Meter. There should be no evidence of any charge remaining on the contact plates.

H. Unit Interconnect. Proceed as follows:

1. Combine the DC Defibrillator Unit and the ECG Monitor/Recorder Unit.

2. Remove the Battery/Pak from the Defibrillator.

3. Use the Digital Multimeter (Table 4-1, Item 2) to make a continuity check between the negative battery terminal on the Defibrillator and contact "F" of the PATIENT CABLE Connector on the ECG Monitor/Recorder.

4. Verify that there is less than 0.1Ω when measured at the "F" contact of the connector.

I. Synchronizer Test.

1. Connect ECG Monitor/Recorder Unit and Defibrillator Unit together.

2. Connect a 1mV ECG signal to the patient cable input of the ECG Monitor/Recorder Unit.

4-59. Functional Checks. (Continued)

I. Synchronizer Test. (Continued)

3. Switch ECG Monitor/Recorder Unit on and adjust ECG SIZE and SYST VOL to obtain an audible beep with each QRS complex.

4. Switch Defibrillator Unit POWER on and observe that the synchronizer indicator is off.

5. Depress the SYNC Pushbutton Switch on the Defibrillator. The SYNC Indicator should blink off momentarily during each R-wave, and each R-wave displayed on the ECG Monitor (CRT) should contain an intensification blip.

6. Turn the Defibrillator POWER off and back on again. The SYNC Indicator should remain off when power is reapplied and the intensification blips should not be present on ECG Monitor (CRT).

7. Set the ENERGY JOULES switch on the APEX paddle to 40 joules. Charge the Defibrillator and discharge into the Energy Meter to insure proper operation.

NOTE: Be sure to discharge into a 50Ω load.

8. Depress the SYNC Pushbutton Switch. Charge the Defibrillator to 40 joules and depress Discharge Pushbuttons. Discharge should only occur during the R-wave detection as indicated by the SYNC light blinking.

9. Check to be sure that discharging the Defibrillator has turned the SYNC off.

10. Repeatedly depress the SYNC Pushbutton Switch on and off and note that the SYNC Indicator turns on and off.

11. With the instrument in the sync mode, slide Defibrillator Unit and ECG Monitor Unit apart. Verify that the SYNC Indicator turns off and there are no intensification blips on the CRT.

12. Verify that the SYNC Indicator cannot be turned on when Defibrillator and ECG Monitor/Recorder Units are separated.

13. Charge the Defibrillator to 40 joules and test fire into a 50Ω load to insure proper operation.

4-60. Component Identification. Figure 4-27 provides an overall view of the LIFEPAK 5 DC Defibrillator unit with key components and test points or adjustments indexed to a legend. Refer to paragraph 4-17 for Major Component Removal and Installation. Refer to Section 5 for a Defibrillator Wire Harness Assembly. Controls and connectors located on the paddles are designated in the text by the exact name shown on the paddles and appear in capital letters with the component number following. For example: POWER switch S3.

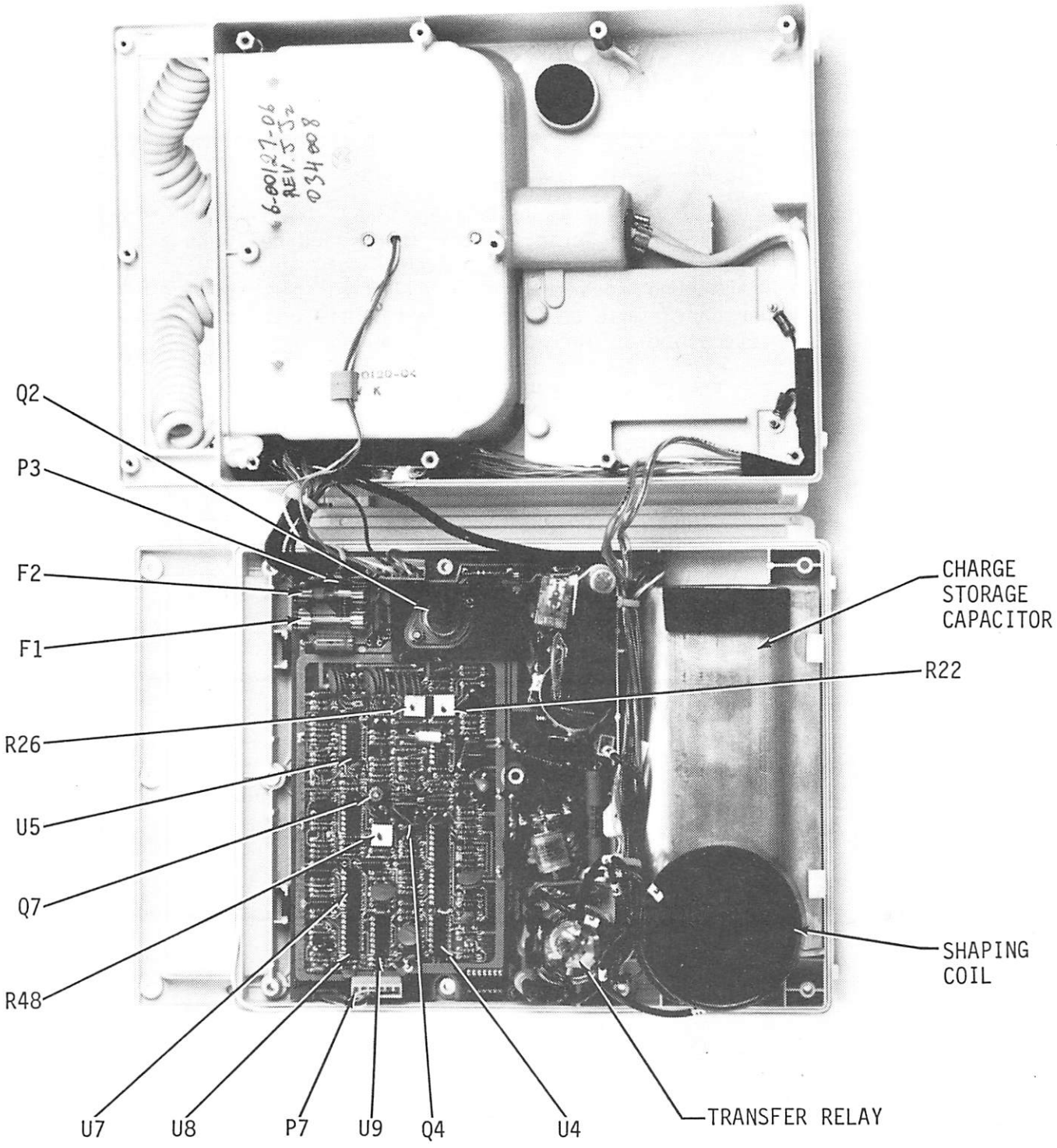


FIGURE 4-27. DC DEFIBRILLATOR COMPONENT IDENTIFICATION

4-61. Troubleshooting. Observe the unit for obvious symptoms such as odors from overheated components, or mechanical malfunctions. Use Table 4-5, Troubleshooting, to identify malfunctions. If corrective action refers to a particular adjustment or calibration, find the reference in paragraph 4-62 through 4-66.

WARNING

The LIFEPAK 5 Defibrillator stores and delivers a potentially hazardous amount of energy if discharged accidentally. All test and service personnel must be familiar with this unit before attempting to work on it.

THE FOLLOWING PRECAUTION SHOULD BE TAKEN:

A. Discharge the main defibrillator capacitor (C1) using an insulated resistor 5K to 20K ohm, 50W, 5KV. The resistor should be connected during all work on the Lifepak 5 Defibrillator Unit, until the unit is ready to operate. The probe or clips used to connect the resistor should be insulated to withstand 20KV.

CAUTION

Special Handling of PCB assemblies containing Electrostatic Sensitive Devices (ESD's)

is required.

TABLE 4-5

DC DEFIBRILLATOR UNIT TROUBLESHOOTING

MALFUNCTION	POSSIBLE CAUSE	CORRECTIVE ACTION
1. Unit does not function when POWER pushbutton S3 is depressed.	a. Battery discharged below operating level.	a. Replace Battery/Pak. POWER indicator will flash when the battery is low.
	b. Defective fuse.	b. Replace if necessary. If fuse opens when power is applied, chk for shorted circuit in system power supply.
	c. Defective on/off circuit.	c. Check on/off relay and related circuitry, including U5, Q8, and Q11. See key waveform number 1, paragraph 4-66.
2. Interference on ECG Monitor when using paddles as ECG pickup.	a. Slide contacts.	a. Check slide contacts of both Units for continuity to paddles and preamp.
	b. Defective paddles.	b. Check paddles.
	c. Defective transfer relay.	c. Check transfer relay contacts for continuity.
3. Stored energy is not delivered to patient when both paddle push-buttons are depressed.	a. Defective paddles.	a. Check continuity of paddle and transfer circuit.
	b. Defective transfer relay or transfer logic circuit.	b. Check transfer logic, including Q4, Q5, U2, and U3. See key waveform number 2, paragraph 4-66.
4. Charge indicator shows no response or fails to reach desired stored energy level.	a. Defective charge control circuitry.	a. Check charge control circuitry.
	b. Defective charge up circuitry.	b. Check charge up circuitry, including Q1, Q2, Q3, Q6, and U1. See key waveform number 3, paragraph 4-66.
	c. Defective energy select circuitry.	c. Check energy select circuitry, including U6 and CR22.

TABLE 4-5 (Continued)

DC DEFIBRILLATOR UNIT TROUBLESHOOTING

MALFUNCTION	POSSIBLE CAUSE	CORRECTIVE ACTION
4. (Continued)	d. Defective paddles.	d. Check paddles
5. Charge time exceeds 10 seconds to reach 320 joule level.	a. Low battery.	a. Recharge or replace battery.
	b. Defective charge up circuitry.	b. Check charge up circuitry, including Q1, 2, 3, 6, 9, and U1. See key waveform Number 3, paragraph 4-66.
	c. Defective charge capacitor.	c. Check capacitor.
6. Stored energy is not dumped instantly when unit is turned off or when paddles are fired in air.	a. Defective dump relay.	a. Replace relay.
	b. Defective dump circuit.	b. Check charge control circuitry, including R3, U2, U3, and U4. See key waveform Number 4, paragraph 4-66.
7. Charge Indicator on steady but stored energy not available.	a. Defective energy select circuitry.	a. Check energy select circuitry including U6 and CR22.
	b. Defective charge control logic.	b. Check charge control logic including U4, U2A and B, and U7A.
8. Bleed off too short.	a. Recharge circuitry defective.	a. Check recharge circuitry, including U4. See key waveform Number 5.
	b. 90% energy comparator circuit.	b. Check U3A, Q10, R58 and R57.
	c. Defective storage capacitor.	c. Replace storage capacitor.
9. Low battery indicator does not light when Battery/Pak is low.	Defective low battery indicator circuitry.	Check low battery indicator circuitry including U6D and U7B.

4-62. Test and Calibration. Procedures given here are used to verify that the LIFEPAK 5 DC Defibrillator unit is operating within specifications. Table 4-5, Troubleshooting, contains references to these procedures. If the instrument is not functioning properly, locate the malfunction before attempting circuit calibration or adjustment. Refer to paragraph 4-61 for information concerning component location. Test equipment is referenced ( ) to Table 4-1.

4-63. Charge and Automatic Recharge Circuit. After completing the Initial Test Set-up in paragraph 4-59 A., proceed as follows:

A. Set ENERGY JOULES Selector, S4, on APEX paddle to 360 joules.

B. Start the Stopwatch (Table 4-1, Item 7) and press CHARGE pushbutton simultaneously.

C. Check that amber CHARGE indicator flashes while charging.

D. Stop the Stopwatch when CHARGE indicator shows a steady light.

E. Check that elapsed time is between 11.25 and 12.5 seconds, and that charge current is less than 10A.

F. Depress the red Discharge Pushbuttons, S2 and S5, and check that the energy is transferred to Energy Meter (Table 4-1, Item 6).

G. If necessary, perform the adjustments in steps H through L.

H. Connect Oscilloscope (Table 4-1, Item 4) to the collector of Q2 or cathode of CR2.

I. Check that ENERGY JOULES Selector is set at 360 joules.

J. Depress the CHARGE pushbutton and observe the waveform on the Oscilloscope. Adjust R22 to obtain waveform number 3 shown on page 4-65.

K. Discharge the stored charge into Energy Meter, and repeat steps A through E. Adjust R26 for a charge time of 11.25 and 12.5 seconds.

L. Repeat steps J through L, and re-adjust R22 and R26 if necessary.

4-64. Selected Energy Test. After completing Initial Setup of paragraph A., proceed as follows to accomplish selected energy:

A. Set ENERGY JOULES Selector, S4, to 360 joules.

B. Depress CHARGE Pushbutton, S6, then immediately press both Discharge Pushbttons, S2 and S5, and hold them down until unit discharges.

C. Verify that the Energy Meter indicates between 338 and 382 joules. If necessary, adjust R48 (compensation) for 360 joules ±5%.

4-64. Selected Energy Test. (Continued)

D. Repeat test on the five other energy levels and verify indication on Energy Meter is within ±10% of the energy level selected as noted in Table 4-6.

E. Repeat steps A through C with the external DC Power Supply set to 10V.

TABLE 4-6

ENERGY JOULES SELECTOR TOLERANCES

ENERGY JOULES	LIMIT (JOULES)
360	338-382
300	282-318
200	188-212
100	94-106
50	47-53
20	18-22

4-65. Energy Waveform and Pulse Duration. After completing Initial Setup in paragraph A., and Selected Energy Test of paragraph 4-64, proceed as follows:

A. Connect the BNC connector (1000:1 oscilloscope output) on the back of the Energy Meter to the Oscilloscope. Set Oscilloscope to 0.5V/div, 1ms/div and positive trigger.

B. Set ENERGY JOULES Selector S4 to maximum energy.

C. Depress CHARGE Pushbutton S6 and allow unit to charge.

D. Depress Discharge Pushbuttons S2 and S5 and observe waveform on the Oscilloscope.

E. The display should closely match that of Figure 4-28. The curve should be smooth and continuous, peak between 48 and 62A and have a half current point at 3.6 ±0.3 ms. The entire pulse duration should be less than 10ms (at 10% peak value).

F. Disconnect and remove Oscilloscope.

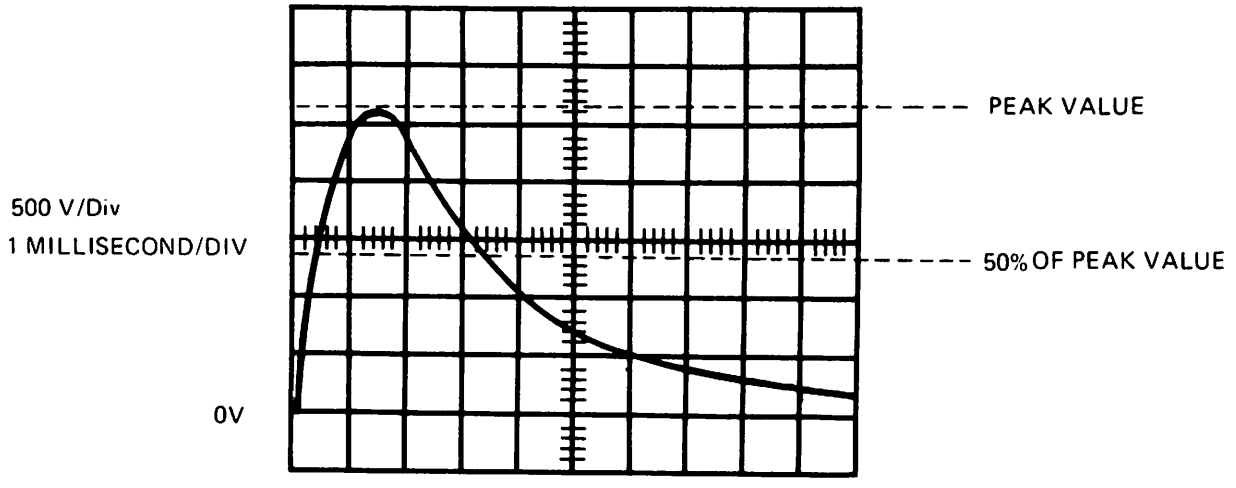


FIGURE 4-28. DC DEFIBRILLATOR OUTPUT WAVEFORM (50Ω)

4-66. Key Waveforms. The following steps provide references to figures providing waveshapes at key points. Using the Oscilloscope observe the waveshapes at the points noted. Refer to Figure 3-12 and 4-22 for help in locating test points.

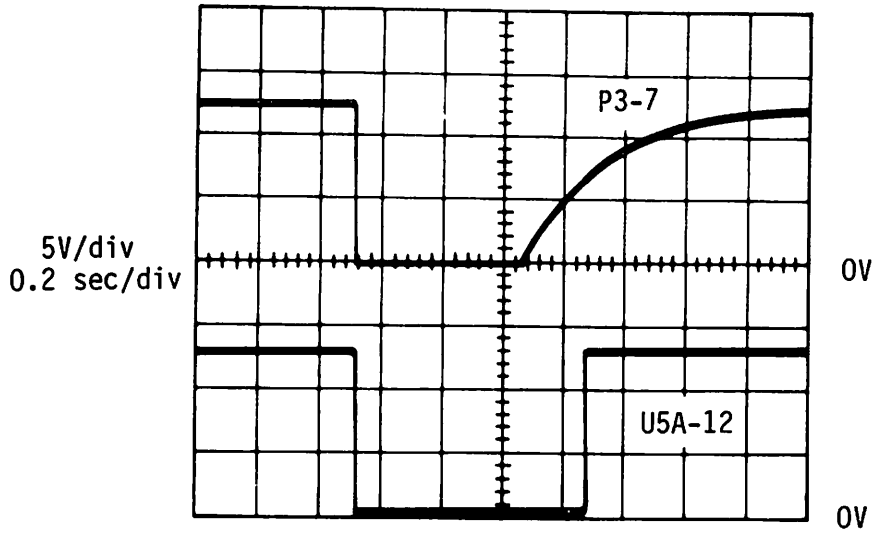
A. "On" Delay Pulse. Check at U5-12; refer to Figure 4-29 waveform number 1.

B. Transfer Pulse. Check at Q4 collector; refer to Figure 4-29 waveform number 2.

C. Capacitor Charge Circuit Output. Check at Q2 collector; refer to Figure 4-29 waveform number 3.

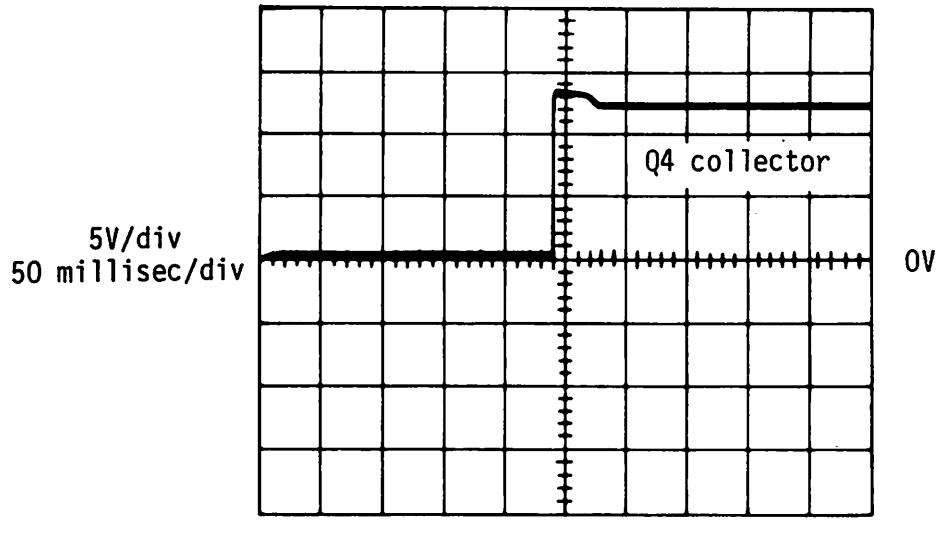
D. Dump Relay Drive Output. Check at Q7 collector; refer to Figure 4-29 waveform number 4.

E. Recharge F/F Output. Check at U4-3; refer to Figure 4-29 waveform number 5.



The delay time is measured from the time the on/off button is released (rise of voltage on P3-7) to the positive transition of U5A-12 (0.2 seconds approximately).

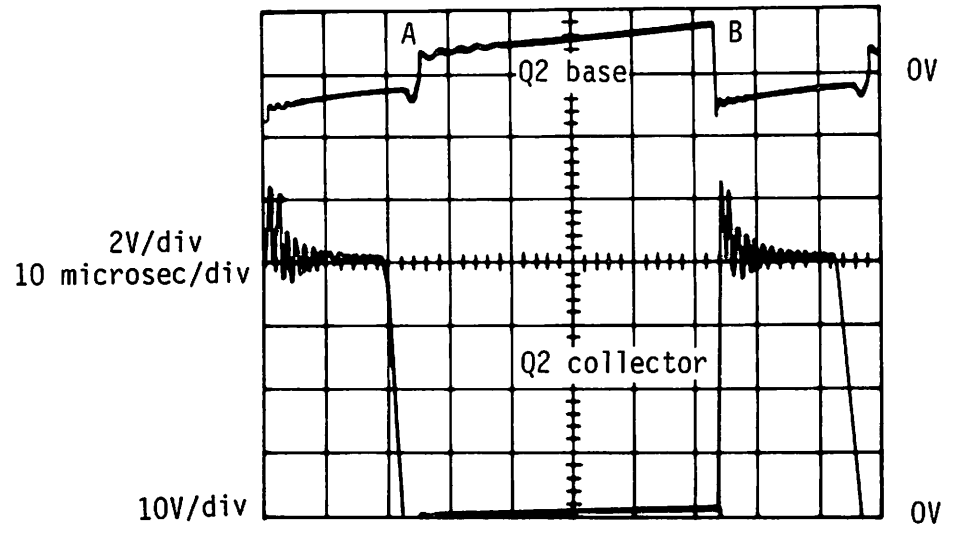
1. On Delay Pulse



Transfer relay coil drive pulse

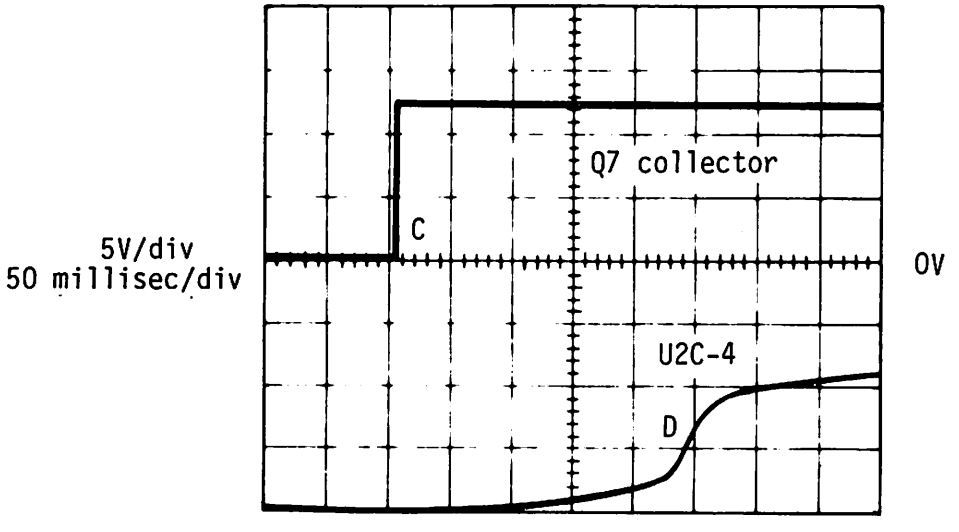
2. Transfer Pulse.

FIGURE 4-29. DC DEFIBRILLATOR KEY VOLTAGE WAVEFORMS



Period A to B is Q2 on time, base voltage upwards ramp is similar to base current ramp. Base current ramp is similar to collector current ramp. Negative spike at B turns Q2 collector off rapidly.

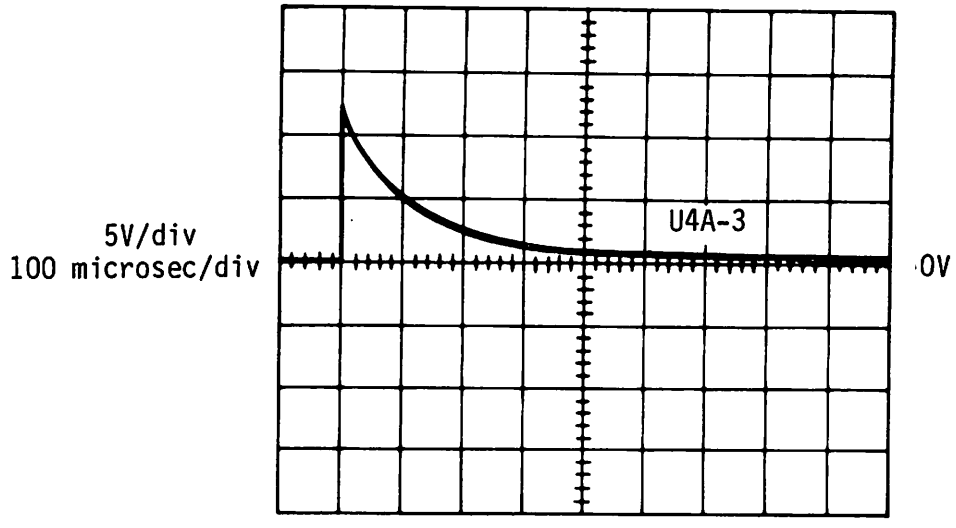
3. Capacitor Charge Circuit Output.



Period C to D is delay allowing dump relay to close before turning on capacitor charge up circuitry.

4. Dump Relay Drive Output.

FIGURE 4-29. DC DEFIBRILLATOR KEY VOLTAGE WAVEFORMS (Continued)



Differentiated recharge pulse at clock input to "D" F/F U4-A-3.

5. Recharge F/F Output.

FIGURE 4-29. DC DEFIBRILLATOR KEY VOLTAGE WAVEFORMS (Continued)

4-67. BATTERY CHARGER UNIT.* (09-00284)

4-68. Functional Checks.

A. Battery Charger Circuit.

1. Connect the Battery Charger Unit to a source of power (115VAC, 230VAC, or 12Vdc).

2. Insert the Battery Pak into the recessed mounting area.

3. Check that the CHARGING indicator lights after about three seconds.

4. After 4-5 hours charging, the TIME indicator should light, showing that charge is complete.

B. Defibrillator Test Load Circuit.

1. Connect the Battery Charger Unit to a source of power (115VAC, 230VAC, or 12Vdc).

2. Turn on a Lifepak 5 Defibrillator and set the ENERGY JOULES selector to 160 joules, on APEX paddle.

3. Press the CHARGE pushbutton and when CHARGE indicator is steady:

4. Apply the paddles to the Test Load Pads on the sides of the Battery Charger Unit.

5. Simultaneously depress the Discharge pushbuttons on both paddles, and observe TEST LOAD indicator.

6. TEST LOAD indicator should flash as the discharge occurs.

7. Set the ENERGY JOULES selector to 80 joules, on APEX paddle.

8. Repeat steps 3, 4 and 5.

9. TEST LOAD indicator should not flash as the discharge occurs.

4-69. Troubleshooting. Observe the unit for obvious symptoms such as odors from overheated components, or mechanical malfunctions. Use Table 4-7, TROUBLESHOOTING, to isolate specific malfunctions. If corrective action refers to a particular adjustment or calibration, find the reference in paragraph 4-71.

***NOTE:** For details of p/n 801807 Battery Support System see separate service manual p/n 802065.

TABLE 4-7

BATTERY CHARGER TROUBLESHOOTING

MALFUNCTION	POSSIBLE CAUSE	CORRECTIVE ACTION
1. TEST LOAD indicator does not flash.	Defibrillator inoperative or out of calibration.	See Defibrillator Section.
	Test load open circuited.	Examine Test Load PCB for open circuit and repair as required.
	TEST LOAD indicator defective.	Replace LED.
2. CHARGING indicator fails to come on when Battery is inserted.	Battery/Pak improperly inserted.	Remove and reinsert Battery/Pak.
	Fuse blown.	Relace 1/4A (115V), 1/2A (220V) or 2A (12Vdc) fuse.
	Defective Battery/Pak.	Replace Battery/Pak.
	Charge Control Logic defective.	Replace U5 on Charger PCB.
	LED and/or Battery/Pak connectors loose or improperly connected.	Check all internal connectors for proper polarity and snug fit
	CHARGING indicator defective.	Replace LED.
	12Vdc Supply Voltage too low.	Increase to specified voltage (11-15Vdc).
3. TIME indicator fails to illuminate.	Faulty Clock (Check signal at TP1).	Replace U3 on Charger PCB and/or associated components as required.
	Faulty Timer.	Replace U7 or U9 on Charger PCB as appropriate.
	Timer Control Logic defective.	Replace U4 on Charger PCB.
	TIME indicator defective.	Replace LED.

TABLE 4-7 (Continued)

BATTERY CHARGER TROUBLESHOOTING

MALFUNCTION	POSSIBLE CAUSE	CORRECTIVE ACTION
4. TIME indicator illuminates too soon or too late.	Faulty Clock (Check signal at TP1).	Replace U3 on Charger PCB and/or associated components as required.
5. Batteries not charged to full capacity when TIME indicator illuminates.	Faulty Battery/Pak.	Replace Battery/Pak.
	Charger being used in too high or too low ambient temperature.	Charge Battery/Pak in ambient temperature as close to room temperature (22°C, 70°F) as possible.
	Charger source out of adjustment.	Adjust R31 or R60 on Charger PCB, as appropriate, to obtain a charge rate of 300mA.
	12Vdc supply voltage too low.	Increase to specified voltage (11 - 15Vdc).
6. TIME and/or CHARGING indicators illuminate when no Battery/Pak is inserted.	Charger control logic defective.	Replace U5 on Charger PCB.

4-70. Component Identification. Figure 4-30 provides an overall view of Battery Charger unit with key components and test points or adjustments indexed to a legend. Refer to paragraph 4-37 for Major Component Removal and Installation.

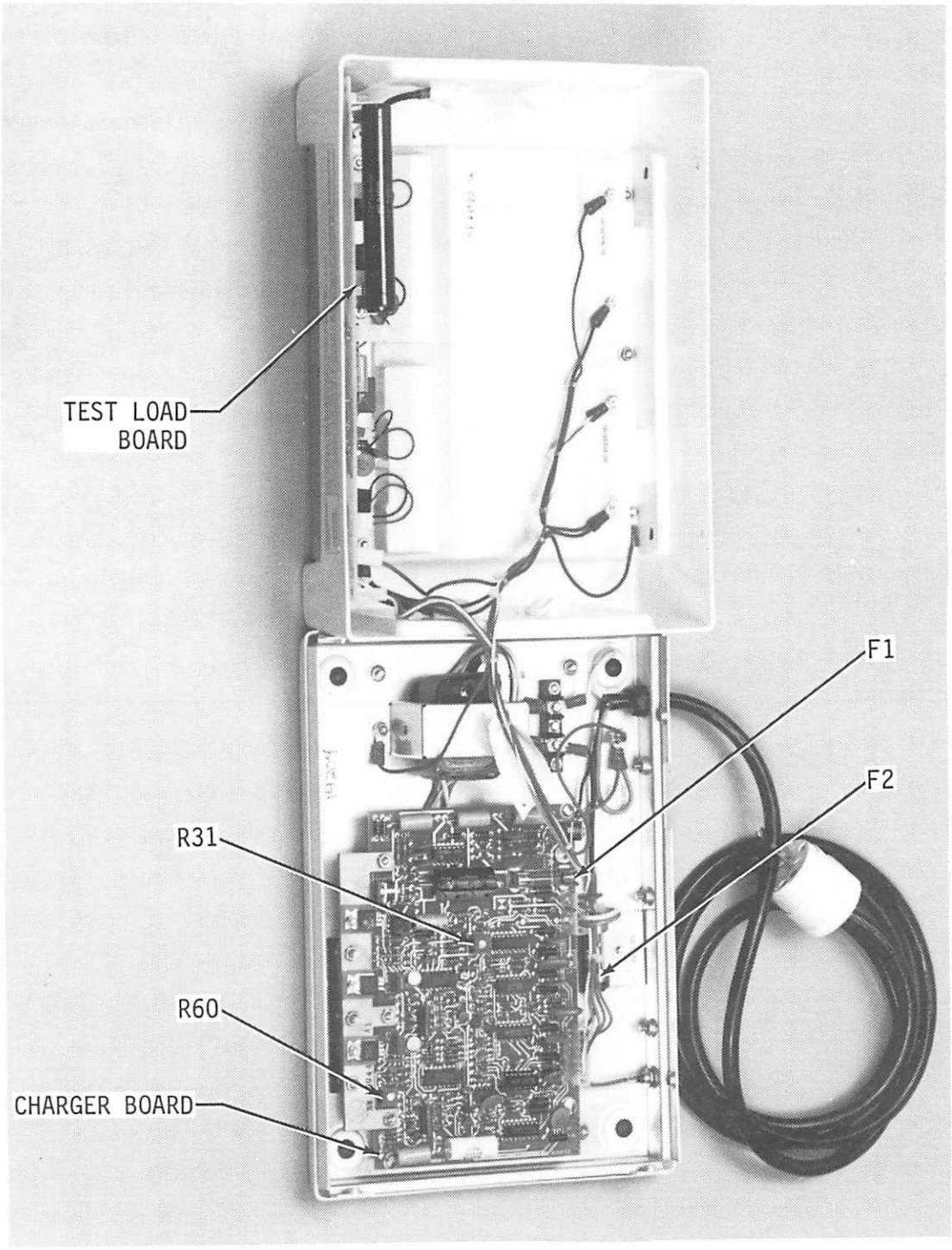


FIGURE 4-30. BATTERY CHARGER UNIT COMPONENT IDENTIFICATION

4-71. Tests and Calibration. Procedures given here are used to verify that the Battery/Pak Charger unit is operating within specifications. Table 4-7, TROUBLESHOOTING, contains references to these procedures. If the instrument is not functioning properly, locate the malfunction before attempting circuit calibration or adjustment. Refer to paragraph 4-70 for information concerning component location. Proceed as follows:

A. Refer to paragraph 4-37 and open up the Battery Charger.

B. Using calibrated LIFEPAK 5 Defibrillator, deliver 80 joules to the Defib TEST LOAD through contact plates. The TEST LOAD Indicator (DS1) should not flash.

C. Repeat step B, but with paddle positions reversed.

D. Using calibrated LIFEPAK 5 Defibrillator, deliver 180 joules to defib TEST LOAD through contact plates. The TEST LOAD Indicator (DS1) should not flash.

E. Repeat step D, but with paddle positions reversed.

F. Connect 20Vdc, 0.5A power supply to power supply input terminals of Variable Test Load (see Figure 4-31). Connect two DMM's, one reading current (2000mA dc scale), and one reading voltage (20 Vdc scale), to the appropriate ammeter and voltmeter connections of the Variable Test Load. Switch Load Select on Variable Test Load to 40Ω position.

G. Plug Charger under test into a 115VAC receptacle. (Or 220V receptacle for units so configured). All indicators should remain off.

H. Insert Variable Test Load (see Figure 4-31), with instrumentation per step F, into right-hand side Battery compartment. Within 3 seconds the right-hand CHARGING indicator should be illuminated. All other LED's should remain off. After the CHARGING indicator comes on, the DMM current reading should be 300mA ±6mA. If not, adjust R31 to obtain a reading of 300mA ±3mA. The DMM voltage reading should be 11.45 to 13.17Vdc.

I. Unplug the Charger under test from the 115VAC (or 220VAC) receptacle. The CHARGING indicator should go out. Wait approximately 5 seconds. Plug the Charger back into the receptacle. Within 3 seconds, the right CHARGING indicator should go back on. All other indicators should remain off. The DMM current reading should then be 300mA ±6mA.

J. Unplug Charger from 115VAC (or 22VAC) receptacle. CHARGING indicator should go out. Using cable with phone plug, connect 11 ±0.1Vdc, 2.5A supply to 12Vdc input jack of Charger. Within 3 seconds, right-hand CHARGING indicator should go on, all other indicators should remain off. The DMM current reading should be 300mA ±5mA.

K. Adjust LOAD ADJUST potentiometer on the Variable Test Load to the full counterclockwise position.

4-71. Tests and Calibration. (Continued)

L. Switch LOAD SELECT to the VARIABLE position. The right-hand CHARGING indicator may go out momentarily, (3 seconds maximum), but should again come on. All other indicators should remain off. The DMM current reading should then be 300mA ± 13mA. The DMM voltage reading should be less than 3.0Vdc.

M. Slowly turn LOAD ADJUST potentiometer clockwise until DMM voltage reading is 13.5 - 14.0Vdc. During this adjustment, the right-hand CHARGING indicator should remain on, all other indicators should remain off, and the DMM current reading should stay within ±13mA of 300mA.

N. Switch LOAD SELECT to the 120Ω position. Again, the right-hand CHARGING indicator may go out momentarily, but should be on again within 3 seconds. All other indicators should remain off. The DMM voltage reading should then be between 14.4 and 15.6Vdc.

O. Disconnect 11Vdc supply from Charger. CHARGING indicator should go out. Switch LOAD SELECT to DISCHARGE position. Adjust ammeter to the 200μA scale. Current reading should be between -20 and -60μA.

P. Switch LOAD SELECT to LEAKAGE position. Plug Charger into 115VAC (or 220VAC) receptacle. Current reading should be less than 80μA, except that a very brief (approximately 5ms) current spike, occurring about 2Ω seconds after unit is plugged in, is acceptable. Current should be observed for at least 7 seconds. All indicators should remain off.

Q. Remove Variable Test Load from Charger.

NOTE: Steps R through AA repeat steps H through Q. References to "right-hand side" should read "left-hand side".

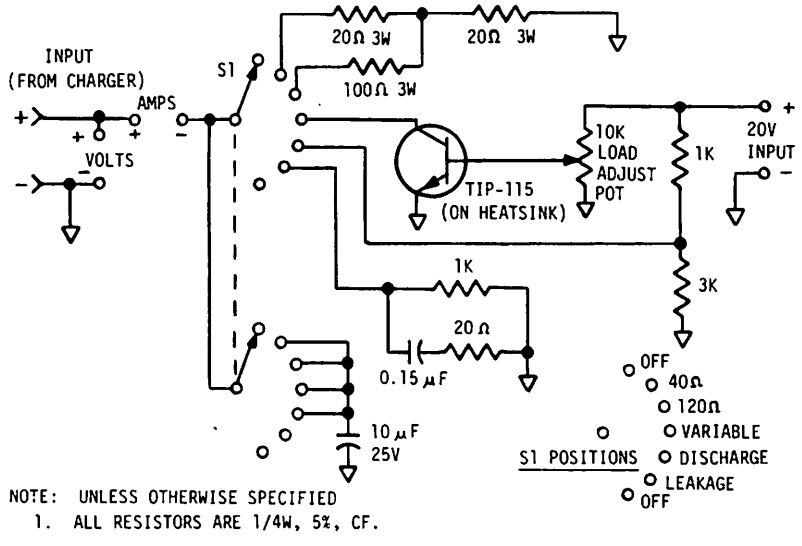


FIGURE 4-31. VARIABLE TEST LOAD, BATTERY CHARGER

4-71. Tests and Calibration. (Continued)

R. Insert the Variable Test Load in the left-hand Battery compartment, repeat step H and adjust R60 if the current is out of tolerance. Observe the left-hand CHARGING indicator.

Repeat step I. Observe left-hand CHARGING indicator.

Repeat step J. Observe left-hand CHARGING indicator.

Repeat step K.

Repeat step L. Observe left-hand CHARGING indicator.

Repeat step M. Observe left-hand CHARGING indicator.

Repeat step N. Observe left-hand CHARGING indicator.

Repeat step O. Observe left-hand CHARGING indicator.

Repeat step P.

AA. Repeat step Q, and unplug unit from AC receptacle.

BB. Connect DMM's so as to read 2000µA dc, between the positive and negative Charger terminals in each Battery compartment of the unit under test. Positive terminal of the DMM should connect to the positive charger terminal in each case.

CC. Adjust the signal generator to deliver a square wave (duty cycle not critical) of 102.4 ±1.0Hz frequency, and 13.5 ±0.2V p-p amplitude.

DD. Using a cable with phone plug, connect 11 ±0.1Vdc, 2.5A supply to 12Vdc input jack of Charger under test. Within 3 seconds, both CHARGING indicators should come on. TIME indicators should remain off. 11Vdc supply current should be 1.4A maximum. The current reading of each DMM connected across Charger terminals should be 300mA ±13mA.

EE. Open the case of the Charger under test. Connect the Signal Generator output ground to the Charger ground lug. Simultaneously connect the signal output to TP 1 on the main Charger PCB, and start the Stopwatch. Close the Charger case as much as possible.

FF. Between 5 and 15 seconds after the Stopwatch is started, and using a LIFEPAK 5 Defibrillator set at the highest joule output available, deliver the Defibrillator pulse to the Test Load contacts of the Charger under test. The condition of the Charger indicators and Charger currents should not change. (A brief flicker on any indicator at the time of Defibrillator discharge is acceptable, and the TEST LOAD Indicator should flash).

4-71. Tests and Calibration. (Continued)

GG. Stop the Stopwatch when both TIME indicators come on. They should come on simultaneously within 0.1 second. The Stopwatch reading should be 20 ±0.4 seconds. Each Charger current reading should then be between 65 and 80mA dc.

HH. Disconnect Signal Generator output and 11Vdc supply from Charger under test. All Charger LED's should go out.

II. Repeat step DD.

JJ. Repeat step EE.

KK. Repeat step FF, except reverse the polarity of the Defibrillator paddles.

LL. Repeat step GG.

MM. Repeat step HH.

4-72. BATTERY MAINTENANCE GUIDE

Paragraphs 4-73 and 4-74 are a guide for maintaining the sealed nickel-cadmium battery system used in the Lifepak 5 cardiac care system. The information is provided to help identify and diagnose problems relating to the battery.

4-73. Failure Modes. The failures that occur in multi-cell batteries will generally fall into one of the following categories:

A. High or Low Resistance Internal Shortcircuits. Internal cell shortcircuits may appear as high or low resistances depending upon the degree and nature of the failure. A cell with a low resistance shortcircuit will not accept a normal charge and will have negligible or no voltage immediately after taking it off charge. A high resistance shortcircuit may accept some charge, but will cause the cell to internally discharge at a higher than normal rate when it is taken off charge. Both types are permanent failures and the battery should be replaced as soon as possible.

There are several adverse conditions which may contribute to internal shortcircuit. Most of these failures occur in multi-cell batteries which have been fully exhausted. Although exhausting a battery will not necessarily cause a shortcircuit, one may develop because there may not be enough internal energy in the battery to burn the shortcircuit away before it is fully established.

The chances of incurring permanent damage are increased as the current, (below cut-off), the ambient temperature, and the time before recharging is increased. Charging at high rates and/or ambient temperature extremes may also cause internal cell shorts, but this occurs less often and can usually be identified if there is an electrolyte residue from the cell vents.

B. Excessive Electrolyte Loss. As a nickel-cadmium cell loses electrolyte, its internal resistance will begin to increase, thus causing a greater drop in the terminal voltage under load. If a sufficient quantity of electrolyte is lost, the cell will also suffer some loss in electrical storage capacity which will be permanent. A cell may lose a small quantity of electrolyte without adversely affecting its performance and may be considered serviceable.

C. Reduction in Capacity and/or Voltage. A more ambiguous type of failure concerns degradation in capacity and/or terminal voltage. This may be either permanent or temporary and its cause is more difficult to determine. Capacity and terminal voltage reduction will occur at the normal end-of-life of a cell or as a result of excessive electrolyte loss. They may also be temporarily reduced by charging at ambient temperature extremes, or resulting from a phenomenon known as "memory".

Both the latter conditions are reversible and can be corrected by charging at room temperature or with the Reconditioning Charge/Discharge Cycle described in paragraph 4-74.

4-73. Failure Modes. (Continued)

C. Reduction in Capacity and/or Voltage. (Continued)

There are two types of "memory" which may occur in sealed nickel-cadmium batteries; one affects capacity and the other affects terminal voltage. The only form of "memory" which is likely to affect batteries in Physio-Control products is the type which causes a slight reduction in terminal voltage. In this case, only the terminal voltage is lowered, usually only by about 20mV per cell. This type of memory will usually not cause a noticeable decrease in the operating time of an instrument, but may cause battery voltage indicators to falsely indicate a low battery condition.

Voltage "memory" is primarily caused by long term, sustained charge rates (C/10 and C/3), and its magnitude is a function of the battery temperature, charge rate and time. A battery is considerably more susceptible to "memory" if it is charged in a 45°C ambient environment than it would be if it were charged in a 25°C environment. The best way to prevent this trouble is to avoid charging the battery in hot environments or for extended periods of time.

4-74. Troubleshooting. Battery failures which render the instrument fully or partially inoperative usually involve a dramatic decrease in terminal voltage. In some cases, there may be little or no reduction in measured capacity, even though there may be a loss in operating time. If, for instance, the battery was charged in a high ambient temperature, it may suffer a reduction in both voltage and capacity. This may not appear during subsequent testing because it is a temporary result of adverse charging conditions. It will correct itself when the battery is charged at normal room temperature or if the charge current is reduced. This will be even more evident in instruments which have tightly enclosed batteries or poor thermal transfer.

Charger and equipment malfunctions may cause a reduction in actual capacity or there may be an apparent loss in capacity because of an erroneous battery level indicator. First identify the malfunction and then determine the cause. In many cases the battery failures are either directly caused or aggravated by adverse operating conditions or practices. Correcting these may prevent or at least delay recurrence of the malfunction.

When diagnosing battery performance problems, it is best to use a 1A constant current test load with a voltage threshold detector to terminate the discharge when cut-off is reached. Using this with a voltage recorder will eliminate load variations, protect the battery from accidental deep discharges and provide a profile record (see Figure 4-32) from which to evaluate subtle variations.

Performance evaluations should be done in an ambient temperature of 20° to 25°C to ensure accuracy.

4-74. Troubleshooting. (Continued)

Reconditioning Charge/Discharge Cycle.

1. Charge the battery at its normal rate.

2. Discharge the battery at C/5 to C rate (approximately 1A) while monitoring the terminal voltage for cut-off.

3. Recharge the battery at its specified overcharge rate (C/10 or 0.3C) in an ambient temperature of about 25°C.

4. Repeat steps 2 and 3.

This should erase any "memory" which may have developed. Compare the recorded voltage profiles for any difference in voltage or capacity. If the average voltage during the first discharge is slightly lower than that of the second discharge, then voltage "memory" was present. This affects only the voltage level and not the real capacity.

Since the average cell voltage is 1.2 - 1.35V, a 10-cell battery should have an average terminal voltage of 12 to 13.5V. If the voltage under a 1A load is 11.8V or less, one or more cells may be shorted. This is especially true if the voltage drop is in multiples of 1.2V.

If the voltage at a 1A discharge does not drop below 12V, or it fluctuates slightly, increase the discharge current by 1A or 2A and observe the terminal voltage.

If the voltage is now below 12V, the battery may have excessive internal resistance which will cause a greater voltage drop as the current is increased. If this creates a problem in the instrument, the battery should be replaced.

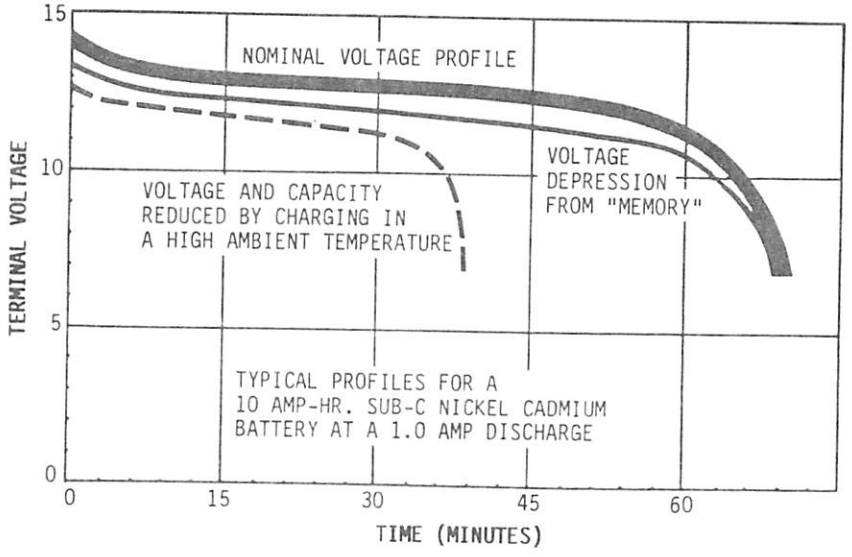


FIGURE 4-32. BATTERY VOLTAGE PROFILE

SECTION 5
ILLUSTRATED PARTS LIST

5-1. GENERAL

This section provides the illustrated parts breakdown lists and describes the parts for the LIFEPAK 5 instrument. Table 5-1 lists the parts lists and assembly drawings for the ECG Monitor/Recorder (Cardioscope), Table 5-2 lists the parts lists and assembly drawings for the DC Defibrillator. Table 5-3 lists the parts lists and assembly drawings for the Battery Charger.

5-2. Parts Lists.

1. **FIG AND ITEM No.** This column contains the Figure Number of the illustrated assembly and the assigned item number for each part.

2. **REF. DES.** (Reference Designation) This column contains alphanumeric listing of electronic designations appearing on the schematic diagram.

3. **PCC PART No.** The Physio-Control Corporation or standard part number is contained in this column for each part listed.

4. **DESCRIPTION** This column contains the nomenclature and descriptive information for each part listed. Electrostatic Sensitive Devices (ESDs) are identified in this column by this symbol (special handling of PCB assemblies containing ESDs is required).

5. **UNITS PER ASSY** This column lists the total quantity of parts for each particular assembly. The abbreviation "REF" (reference) indicates that the part has been listed for reference purposes.

6. **USED ON CODE** This column contains an alphabetical code which indicates configuration differences. Consult the first entry in the parts list for code effectivity.

5-3. Part Ordering. Some parts may be purchased locally. When ordering from Physio-Control Corporation, give the instrument model number and serial number. Include information listed in the parts list under headings: **REF. DES., PCC PART No., DESCRIPTION.** Also include component values. Different parts may be substituted by Physio-Control to reflect modifications and improvements of instrument circuitry.

TABLE 5-1

ECG MONITOR/RECORDER PARTS LIST AND ASSEMBLY DRAWINGS

DRAWING NO.*	NOMENCLATURE	FIGURE NO.
09-00283	ECG MONITOR/RECORDER FINAL ASSEMBLY	5-1
04-50083	ECG MONITOR/RECORDER WIRING DIAGRAM	5-2
05-00308	SYNCHRONIZER PCB ASSEMBLY	5-3
05-00284	PREAMP PCB ASSEMBLY	5-4
05-00291	NO-FADE PCB ASSEMBLY	5-5
05-00289	POWER SUPPLY AND RECORDER PCB ASSEMBLY	5-6
801070	RECORDER ASSEMBLY	5-7

TABLE 5-2

DC DEFIBRILLATOR PARTS LIST AND ASSEMBLY DRAWINGS

DRAWING NO.*	NOMENCLATURE	FIGURE NO.
09-00285	DEFIBRILLATOR FINAL ASSEMBLY	5-8
06-00127	UPPER CASE COMPONENTS AND ASSEMBLY	5-9
04-50081	DEFIBRILLATOR WIRE HARNESS ASSEMBLY	5-10
05-00286	MAIN DEFIB PCB ASSEMBLY	5-11
801271	PADDLE ASSEMBLY	5-12

TABLE 5-3

BATTERY/PAK CHARGER PARTS LIST AND ASSEMBLY DRAWINGS

DRAWING NO.*	NOMENCLATURE	FIGURE NO.
09-00284	BATTERY CHARGER FINAL ASSEMBLY	5-13
04-50084	BATTERY CHARGER WIRE HARNESS ASSEMBLY	5-14
800413	BATTERY CHARGER PCB ASSEMBLY	5-15
05-00298	TEST LOAD PCB ASSEMBLY	5-16

* Check Change Information section at the rear of this manual.

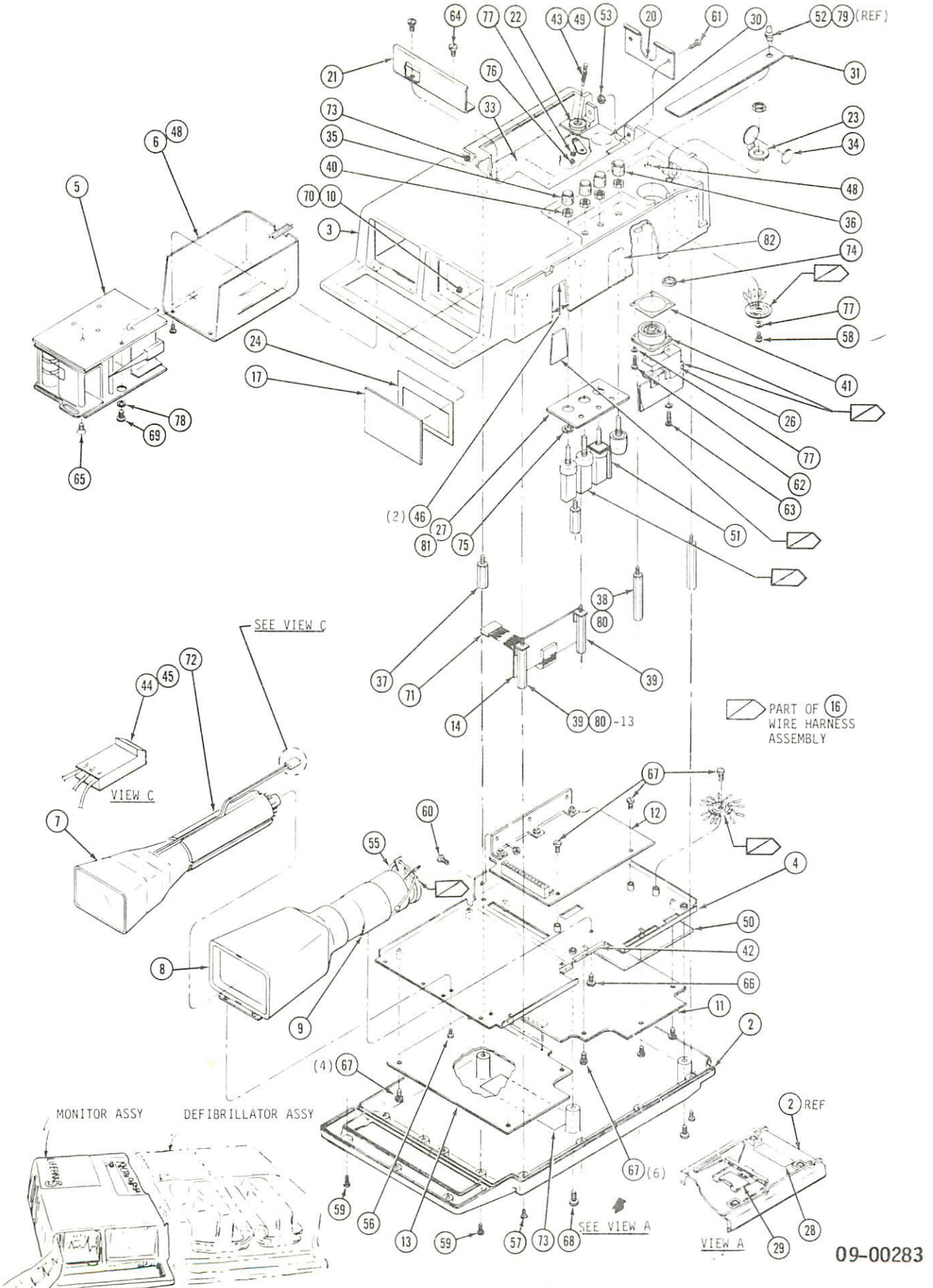


FIGURE 5-1. ECG MONITOR/RECORDER FINAL ASSEMBLY
(SHEET 1 OF 2)

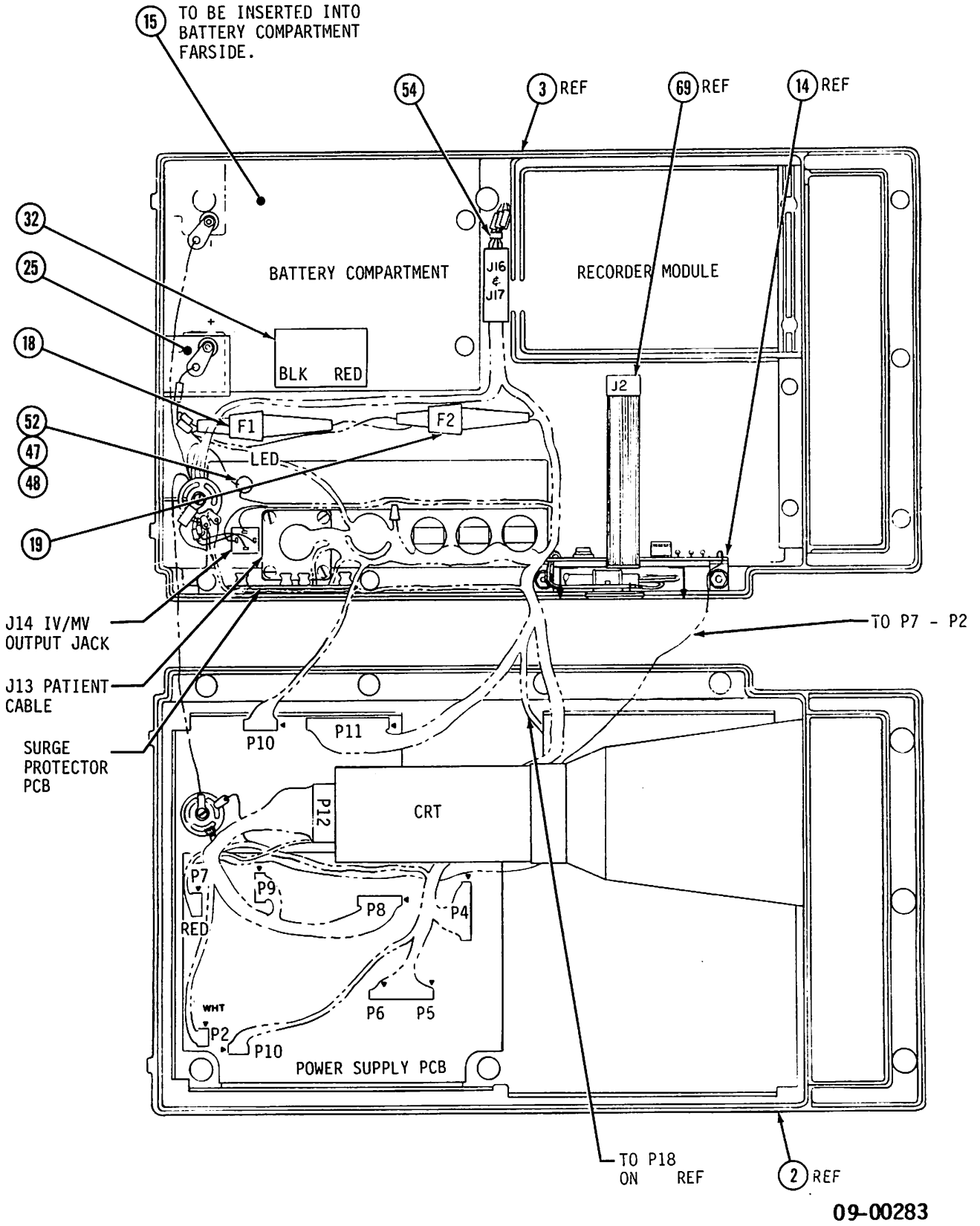


FIGURE 5-1. ECG MONITOR/RECORDER FINAL ASSEMBLY
(SHEET 2 OF 2)

PARTS LIST

FIG AND ITEM NO.	REF. DES.	PCC PART NO.	DESCRIPTION	UNITS PER ASSY	USED ON CODE
5-1					
1		09-00283-14	MONITOR FINAL ASSY, LP/5 DOMES, C/R	REF	A
		09-00283-15	MONITOR FINAL ASSY, LP/5 CSA	REF	B
		09-00283-16	MONITOR FINAL ASSY, LP/5, 50Hz INT'L ENGLISH	REF	C
		09-00283-17	MONITOR FINAL ASSY, LP/5, 60Hz ENGLISH, CSA, C/R	REF	D
		801529-00	MONITOR FINAL ASSY, LP/5, 60Hz FRENCH, CSA	REF	E
		801529-02	MONITOR FINAL ASSY, LP/5, 50Hz GERMAN	REF	G
		801529-06	MONITOR FINAL ASSY, LP/5, 50Hz FRENCH	REF	F
		801529-07	MONITOR FINAL ASSY, LP/5, 50Hz SPANISH	REF	H
		801529-08	MONITOR FINAL ASSY, LP/5, 60Hz SPANISH	REF	I
		801529-09	MONITOR FINAL ASSY, LP/5, 60Hz FRENCH, CSA, C/R	REF	J
2		800232-01	LOWER CASE ASSY, ENCLOSURE	1	
3		06-00118-05	UPPER CASE ASSY, ENCLOSURE	1	B,C,E, F,G,H, I
		06-00118-07	UPPER CASE ASSY, ENCLOSURE	1	A,D,J
4		01-41448-03	CHASSIS, MONITOR	1	
5		801070-01	RECORDER ASSY	1	
6		01-41558-01	ENCLOSURE, RECORDER	1	
7		02-16017-02	CRT, ELECTROSTATIC (CSA)	1	
8		01-41427-02	SHIELD, CRT	1	
9		801417-00	INSULATOR, CRT	1	
10		01-41564-00	STATIC SHIELD, CRT	1	
11		05-00284-08	PREAMP PCB ASSY, 60HZ	1	B,E,I
		05-00284-12	PREAMP PCB ASSY, 50HZ, TUV	1	C,F, G,H
		05-00284-14	PREAMP PCB ASSY, 60HZ, C/R	1	A,D,J

PARTS LIST

FIG AND ITEM NO.	REF. DES.	PCC PART NO.	DESCRIPTION	UNITS PER ASSY	USED ON CODE
5-1					
12		05-00289-03	PWR SUPPLY, RECORDER PCB ASSY	1	
13		05-00291-07	NO-FADE PCB ASSY	1	
14		05-00308-02	SYNCHRONIZER PCB ASSY	1	A,B,C, D,F,G, H,J
		05-00308-03	SYNCHRONIZER PCB ASSY, TUV	1	E,I
15		09-10424-02	BATTERY PAK	1	
16		04-50083-09	WIRE HARNESS ASSY	1	A,B,D, E,I,J
		04-50083-11	WIRE HARNESS ASSY	1	C,F, G,H
17		801405-02	FRONT PANEL	1	A,B, C,D
18	F1	200281-022	FUSE, FAST, 2A/250V	1	
19	F2	200281-018	FUSE, FAST, 1A/250V	1	
20		01-41528-00	PLATE, LATCH	1	
21		01-41540-01	RETAINER, BATTERY PAK	1	
22		01-41542-00	SEAL, BATTERY PAK	2	
23		01-41568-01	COVER, JACK (ECG OUT)	1	
24		01-41588-00	GASKET, ADHESIVE	1	
25		800564-00	INSULATOR, PAPER	1	
26		01-41637-02	INSULATOR, PCB	1	
27		01-41638-01	INSULATOR, SWITCH	1	
28		01-50316-06	LABEL, DANGER, EXPLOSION	1	A,B, C,D
29		01-50318-04	LABEL, CAUTION, SHOCK	1	A,B, C,D
30		200795-000	LABEL, CITY OF L.A.	1	A,B
31		01-50326-06	LABEL, CONTROL PANEL	1	A,B, C,D
32		801362-02	LABEL, FUSE WARNING	1	A,B,D
		801658-00	LABEL, FUSE WARNING	1	C,E,F, G,H,I, J

PARTS LIST

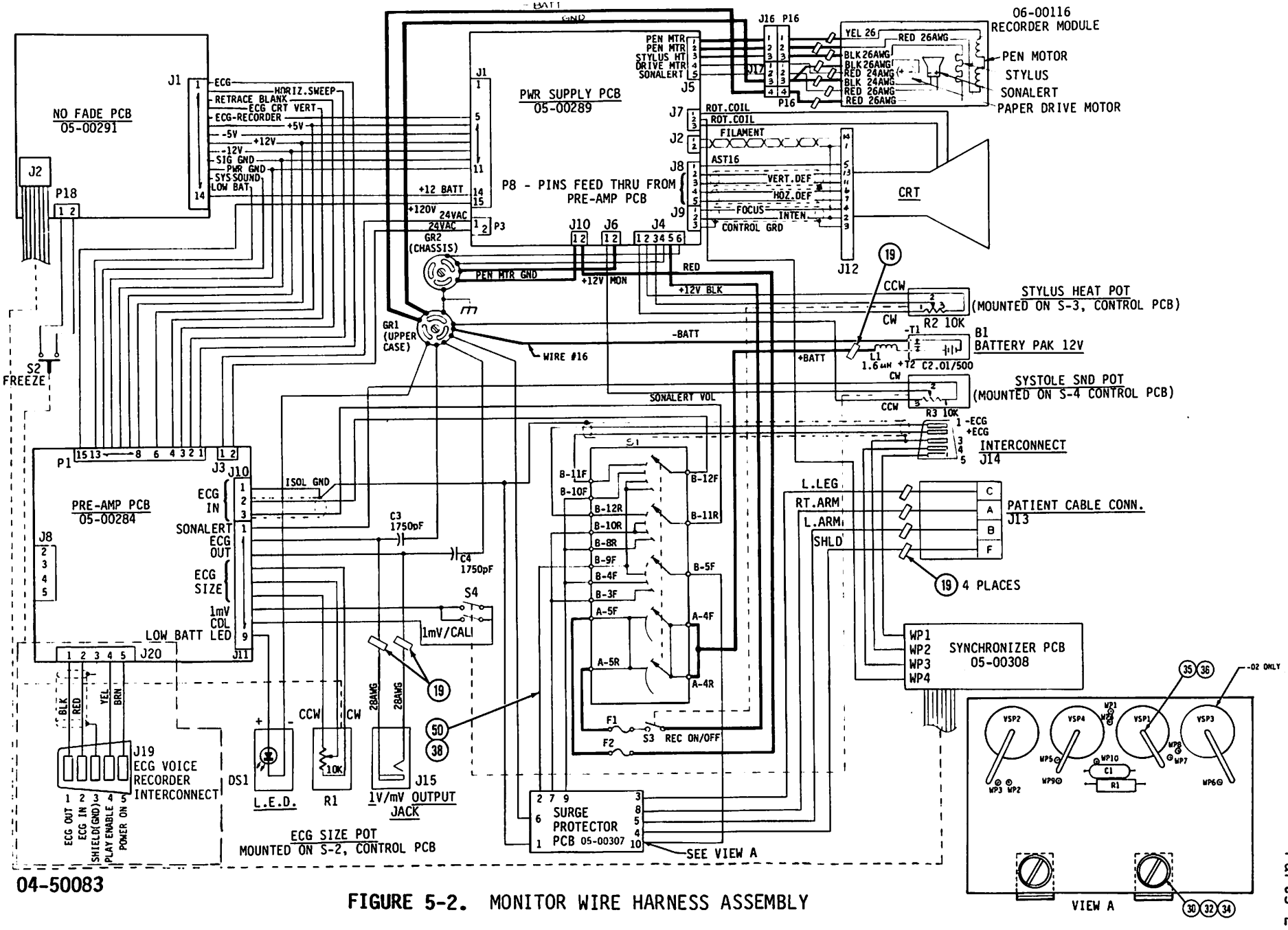
FIG AND ITEM NO.	REF. DES.	PCC PART NO.	DESCRIPTION	UNITS PER ASSY	USED ON CODE
5-1					
33		801518-00	LABEL, SERIAL NO.	1	A,C,D
		801518-02	LABEL, SERIAL NO.	1	B
34		02-35202-00	FOOT, STICK-ON, BLACK	1	
35		01-41563-00	KNOB, CONTROL	3	
36		200126-011	KNOB, INSTRUMENT, 1/8 SHAFT	1	
37		200192-526	STANDOFF, M/F, 6-32 x 1, HEX, AL	2	
38		200266-058	STANDOFF, M/F, 4-40 x 2, HEX, SS	2	
39		200266-056	STANDOFF, M/F, 4-40 x 1.9, HEX, SS	2	
40		02-35482-00	SEAL, SHAFT	4	
41		01-35490-00	GASKET, FLUID SEAL	1	
42		02-35189-00	GROMMET, CONTINUOUS, NYLON	A/R	
43		201171-000	CONNECTOR, BANANA PLUG, MINI, 4-40	2	
44	J7	200277-001	CONNECTOR, RECPT, HOUSING, 3 PIN	1	
45		200390-006	TERMINAL, SKT,, CRIMP, 22-26 AWG	2	
46		02-35531-00	LUBRICANT, LITHIUM GREASE, WHT	A/R	
47		90-09251	RTV PRIMER, SEALANT	A/R	
48		90-09035	SEALANT, RTV 102, WHT	A/R	
49		90-09085	ADHESIVE, LOCKTITE 290	A/R	
50		801898-00	SHIELD, PREAMP PCB, NOMEX PAPER	1	
51		801902-00	SHIELD, CAL SWITCH	1	
52		200057-000	LED, RED, RND, SNAP IN	1	
53		90-03019	KEPNUT, 4-40 x 1/4, CP, CS	6	
54		90-10055	RETAINER, CABLE TIE, NYLON	2	
55		90-10054	RETAINER, CABLE TIE, NYLON	1	
56		200365-002	SCREW, 4-40 x 3/16, PH, S, SS, NYLOK	2	
57		02-35529-00	SCREW, 4-40 x 1/4, PH, S, SS, LOCK	4	
58		200475-260	SCREW, 4-40 x 1/4, BH, S, CP, CS	1	
59		02-35529-01	SCREW, 4-40 x 5/16, PH, S, SS, LOCK	7	
60		200478-761	SCREW, 4-40 x 5/16, FH, P, CP, CSK	3	
61		90-01195	SCREW, 4-40 x 5/16, FH, P, SS, NYLOK	2	
62		200475-262	SCREW, 4-40 x 3/8, BH, S, CP, CS	2	

PARTS LIST

FIG AND ITEM NO.	REF. DES.	PCC PART NO.	DESCRIPTION	UNITS PER ASSY	USED ON CODE
5-1					
63		200475-263	SCREW, 4-40 x 7/16, BH, S, CP, CS	2	
64		200531-011	SCREW, 6-19 x 3/16, PH, P, CP, S/TAP	2	
65		200478-291	SCREW, 6-32 x 3/16, FH, S, CP, CS	1	
66		200366-003	SCREW, 6-32 x 1/4, PH, S, SS, NYLOK	1	
67		200475-292	SCREW, 6-32 x 1/4, BH, S, CP, CS	13	
68		02-35530-03	SCREW, 6-32 x 3/8, PH, S, SS, LOCK	4	
69		200475-324	SCREW, 8-32 x 1/4, BH, S, CP, CS	3	
70		02-35504-00	TAPE, POLY FILM, 1/4	A/R	
71		90-08027	TAPE, WEATHERSTRIP, 3/4	A/R	
72		90-08010	TAPE, MASKING, 1.0	A/R	
73		90-08030	TAPE, MYLAR, YEL, 2.0	A/R	
74		800116-00	WASHER, SPECIAL, FLAT	1	
75		200014-000	WASHER, LOCK I.T., 1/4	4	
76		90-03001	NUT, HEX, 4-40, CS, CP	4	E,I
		90-03001	NUT, HEX, 4-40, CS, CP	2	A,B,C, D,F,G, H,J
77		90-04005	WASHER, LOCK I.T., SS #4	9	
78		90-04017	WASHER, LOCK I.T., SS #8	3	
79		200058-003	SOCKET, LED MOUNTING	1	
80		200283-020	HEATSHRINK TUBING	A/R	C,G, F,H
81		90-08001	TRANSFER ADHESIVE	A/R	
82		802177-00	INTERCONNECT CASSETTE RECORDER	1	A,D,J
83	*	801451-05	MONITOR, LABEL ASSY KIT, SPANISH	1	H,I
		801405-06	FRONT PANEL, MONITOR, SYNC	1	H,I
		01-50318-07	LABEL, CAUTION, SHOCK	1	H,I
		01-50316-09	LABEL, CAUTION, EXPLOSION	1	H,I
	1.	801518-00	LABEL, SERIAL NUMBER	1	H,I
		01-50326-09	LABEL, CONTROL PANEL	1	H,I
		801461-02	LABEL, ECG OUTPUT	1	H,I
		801456-02	LABEL, PUSH KNOB	3	H,I

PARTS LIST

FIG AND ITEM NO.	REF. DES.	PCC PART NO.	DESCRIPTION	UNITS PER ASSY	USED ON CODE
5-1					
84		801452-07	MONITOR, LABEL ASSY KIT, FRENCH, CSA	1	E,J
		801452-09	MONITOR, LABEL ASSY KIT, FRENCH	1	F
		801405-03	LABEL, FRONT PANEL, MONITOR	1	E,F,J
		01-50318-05	LABEL, CAUTION, SHOCK	1	E,F,J
		01-50316-07	LABEL, DANGER, EXPLOSION	1	E,F,J
	2.	801518-02	LABEL, SERIAL NUMBER	1	E,J
		801518-03	LABEL, SERIAL NUMBER	1	F
		01-50326-07	LABEL, CONTROL PANEL	1	E,F,J
		800522-01	LABEL, ECG CAUTION	1	E,J
		801461-00	LABEL, ECG OUTPUT	1	E,F,J
		801456-00	LABEL, PUSH KNOB	3	E,F,J
85		801453-04	MONITOR, LABEL ASSY KIT, GERMAN	1	F
		801405-05	FRONT PANEL	1	F
		01-50318-06	LABEL, CAUTION, SHOCK	1	F
		01-50316-08	LABEL, DANGER, EXPLOSION	1	F
		801518-04	LABEL, SERIAL NUMBER	1	F
	3.	01-50326-08	LABEL, CONTROL PANEL	1	F
		801461-01	LABEL, ECG OUTPUT	1	F
		801456-01	LABEL, PUSH KNOB	3	F
		800826-04	LABEL, OPERATING INSTRUCTIONS	1	F
		*	ITEMS 83-85 NOT SHOWN ON DRAWING.		
		1.	PART OF ITEM 83 801451		
		2.	PART OF ITEMS 84 801452		
		3.	PART OF ITEM 85 801453		



04-50083

FIGURE 5-2. MONITOR WIRE HARNESS ASSEMBLY

PARTS LIST

FIG AND ITEM NO.	REF. DES.	PCC PART NO.	DESCRIPTION	UNITS PER ASSY	USED ON CODE
5-2					
1		04-50083-09	MONITOR WIRE HARNESS ASSY	REF	A
		04-50083-10	MONITOR WIRE HARNESS ASSY, C/R	REF	B
		04-50083-11	MONITOR WIRE HARNESS ASSY, TUV	REF	C
2		200404-042	CABLE, SHLD, 2 COND, #22, STRND, CSA	A/R	
3	C3,4	200473-000	FILTER, LOW PASS, EMI, HF, 1750pF	2	
4	J2,6,10	200277-000	CONNECTOR, HSNG, RCPT, 2 PIN	3	
5	J4	200277-004	CONNECTOR, HSNG, RCPT, 6 PIN	1	
6	J5	200277-003	CONNECTOR, HSNG, RCPT, 5 PIN	1	
7	J8	02-20375-00	CONNECTOR, PLUG, CRIMP, 5 PIN	1	
8	J9,10	200277-001	CONNECTOR, HSNG, RCPT, 3 PIN	2	
9	J11	200419-026	CONNECTOR, HSNG, RCPT, 9 PIN	1	
10	J12	800023-00	CONNECTOR, CRT, RCPT, MODIFIED	1	
11	J13	801050-01	CONNECTOR, PLUG, CIRCULAR, 6 PIN	1	
12	J14	06-00115-02	INTERCONNECT ASSY	1	A,C
		06-00115-02	INTERCONNECT ASSY	2	B
13	J15	02-20370-00	CONNECTOR, RCPT, PHONE JACK, MINI	1	
14	J16,17	200777-006	CONNECTOR, HSNG, RCPT, 4 PIN	2	
15	J18	200419-019	CONNECTOR HOUSING, RCPT, 2 PIN	1	
16		200864-008	TERMINAL, SKT, CRIMP, 18-22	7	
17		200390-006	TERMINAL, SKT, CRIMP, 22-26	24	
18		200390-000	TERMINAL, SKT, CRIMP, 22-30	11	A,C
		200390-000	TERMINAL, SKT, CRIMP, 22-30	16	B
19		02-35456-00	FERRITE BEAD, INDUCTOR	7	
20	F1	800087-00	FUSEHOLDER, BLK, RETAINER	1	
21	F2	800087-01	FUSEHOLDER, RED, RETAINER	1	
22	GR1,2	200814-000	GROUND RING, TERMINAL, RND	2	
23	L1	200757-000	INDUCTOR, CHOKE, 80-180 MHZ	1	
24		200276-210	LUG, RING TERMINAL, #4, 22-16	2	
25		200276-211	LUG, RING TERMINAL #6 RED	3	
26		02-35535-00	NUT, RND, PUSH #4	1	A,C
		02-35535-00	NUT, RND, PUSH #4	2	B

PARTS LIST

FIG AND ITEM NO.	REF. DES.	PCC PART NO.	DESCRIPTION	UNITS PER ASSY	USED ON CODE
5-2					
27		90-09035	RTV, WHITE SEALANT, #102	A/R	
28	SP1,2	90-10001	SPLICE, CLOSED END, TERMINAL	2	
29		05-00307-02	SURGE PROTECTOR PCB ASSY	1	A,B
		05-00307-03	SURGE PROTECTOR PCB ASSY	1	C
30		01-41636-00	BRACKET, MTG, PCB	2	
31	C1	200593-001	CAPACITOR, DISC, RAD, 100pF/1KV, 10%	1	
32		90-04005	LOCK WASHER, #4	2	
33	R1	200054-413	RESISTOR, MF, 200K, 1/8W, 1%, RN55C	1	
34	1.	200475-259	SCREW, 4-40 X 3/16, BH, S, CS, CP	2	
35		200624-005	TUBING, TEFLON, NAT, .034 ID	A/R	
36		200930-006	TUBING, HEAT SHRINK, NAT, .375 ID	A/R	
37	VSP1, 2,4	200324-001	VOLT SURGE PROCT, 90, 1pF, B1-C90/20	3	
38	VSP3	200324-013	VOLT SURGE PROCT, 920, 1pF, SELECT	1	
39	S1	801377-08	SWITCH, ROTARY, 5 POS, 5 POLE	1	A,B
		802050-00	SWITCH, ROTARY, 5 POS, 5 POLE PRETEST	1	C
40	S2,4	02-22247-06	SWITCH, POT (MOMENTARY), 4 POS, 2 POLE	2	
41	S3	02-22247-05	SWITCH, POT (PUSH-PUSH), 4 POS, 2 POLE	1	
42		200474-002	TERMINAL, LUG, SOLDER #6	2	
43		90-07022	TUBING, PVC #8, CLR	A/R	
44		200624-009	TUBING, TEFLON, NTL, .053	A/R	
45		200624-005	TUBING, TEFLON, NTL, .032	A/R	
46		200624-000	TUBING, TEFLON, NTL, .012	A/R	
47		200930-003	TUBING, SHRINK 1/8, RED	A/R	
48		200283-017	TUBING, SHRINK 1/8, BLK	A/R	
49		200283-018	TUBING, SHRINK 3/16, BLK	A/R	
50		200283-020	TUBING, SHRINK 3/8, BLK	A/R	
51		200283-021	TUBING, SHRINK 1/2, BLK	A/R	
52		200596-000	WIRE, STRND, TEF, 600V, 28 AWG, WHT, CSA	A/R	

PARTS LIST

FIG AND ITEM NO.	REF. DES.	PCC PART NO.	DESCRIPTION	UNITS PER ASSY	USED ON CODE
5-2					
53		200596-001	WIRE, STRND, TEF, 600V, 28 AWG, YEL, CSA	A/R	
54		200530-002	RETAINER, CABLE CLAMP	1	A,C
		200530-002	RETAINER, CABLE CLAMP	2	B
55		200862-004	PIN, CRIMP TERMINAL #18-22	1	
56		201125-000	TERMINAL, RECPT, CRIMP #22-26	2	
57		200357-108	WIRE, STRND, PVC, 300V, 22 AWG, WHT, CSA	A/R	
58		200357-109	WIRE, STRND, PVC, 300V, 22 AWG, BLK, CSA	A/R	
59		200357-110	WIRE, STRND, PVC, 300V, 22 AWG, RED, CSA	A/R	
60		200357-114	WIRE, STRND, PVC, 300V, 22 AWG, BRN, CSA	A/R	
61		200357-116	WIRE, STRND, PVC, 300V, 22 AWG, GRA, CSA	A/R	
62		200357-117	WIRE, STRND, PVC, 300V, 22 AWG, VIO, CSA	A/R	
63		200357-118	WIRE, STRND, PVC, 300V, 22 AWG, WHT/BLK, CSA	A/R	
64		200357-123	WIRE, STRND, PVC, 300V, 22 AWG, WHT/BRN, CSA	A/R	
65		200357-162	WIRE, STRND, PVC, 300V, 26 AWG, WHT, CSA	A/R	
66		200357-164	WIRE, STRND, PVC, 300V, 26 AWG, RED, CSA	A/R	
67		200357-166	WIRE, STRND, PVC, 300V, 26 AWG, YEL, CSA	A/R	
68		200357-167	WIRE, STRND, PVC, 300V, 26 AWG, BLU, CSA	A/R	
69		200357-168	WIRE, STRND, PVC, 300V, 26 AWG, BRN, CSA	A/R	
70		200357-169	WIRE, STRND, PVC, 300V, 26 AWG, ORN, CSA	A/R	

PARTS LIST

FIG AND ITEM NO.	REF. DES.	PCC PART NO.	DESCRIPTION	UNITS PER ASSY	USED ON CODE
5-2					
71		200357-170	WIRE, STRND, PVC, 300V, 26 AWG, GRA, CSA	A/R	
72		200357-171	WIRE, STRND, PVC, 300V, 26 AWG, VIO, CSA	A/R	
73		200357-172	WIRE, STRND, PVC, 300V, 26 AWG, WHT/BLK, CSA	A/R	
74		200357-173	WIRE, STRND, PVC, 300V, 26 AWG, WHT/RED, CSA	A/R	
75		200357-174	WIRE, STRND, PVC, 300V, 26 AWG, WHT/GRN, CSA	A/R	
76		200357-175	WIRE, STRND, PVC, 300V, 26 AWG, WHT/YEL, CSA	A/R	
77		200357-176	WIRE, STRND, PVC, 300V, 26 AWG, WHT/BLU, CSA	A/R	
78		200357-028	WIRE, STRND, PVC, 300V, 16 AWG, BLK, CSA	A/R	
79		90-09138	WIRE, #22 BUSS, SOLID	A/R	
80	J20	200419-022	CONNECTOR, HSNG, RECPT, 5 PIN	1	B
81		200357-112	WIRE, STRND, PVC 300V, 22 AWG, YEL, CSA	A/R	B
		1.	PART OF ITEM 29, 05-00307		

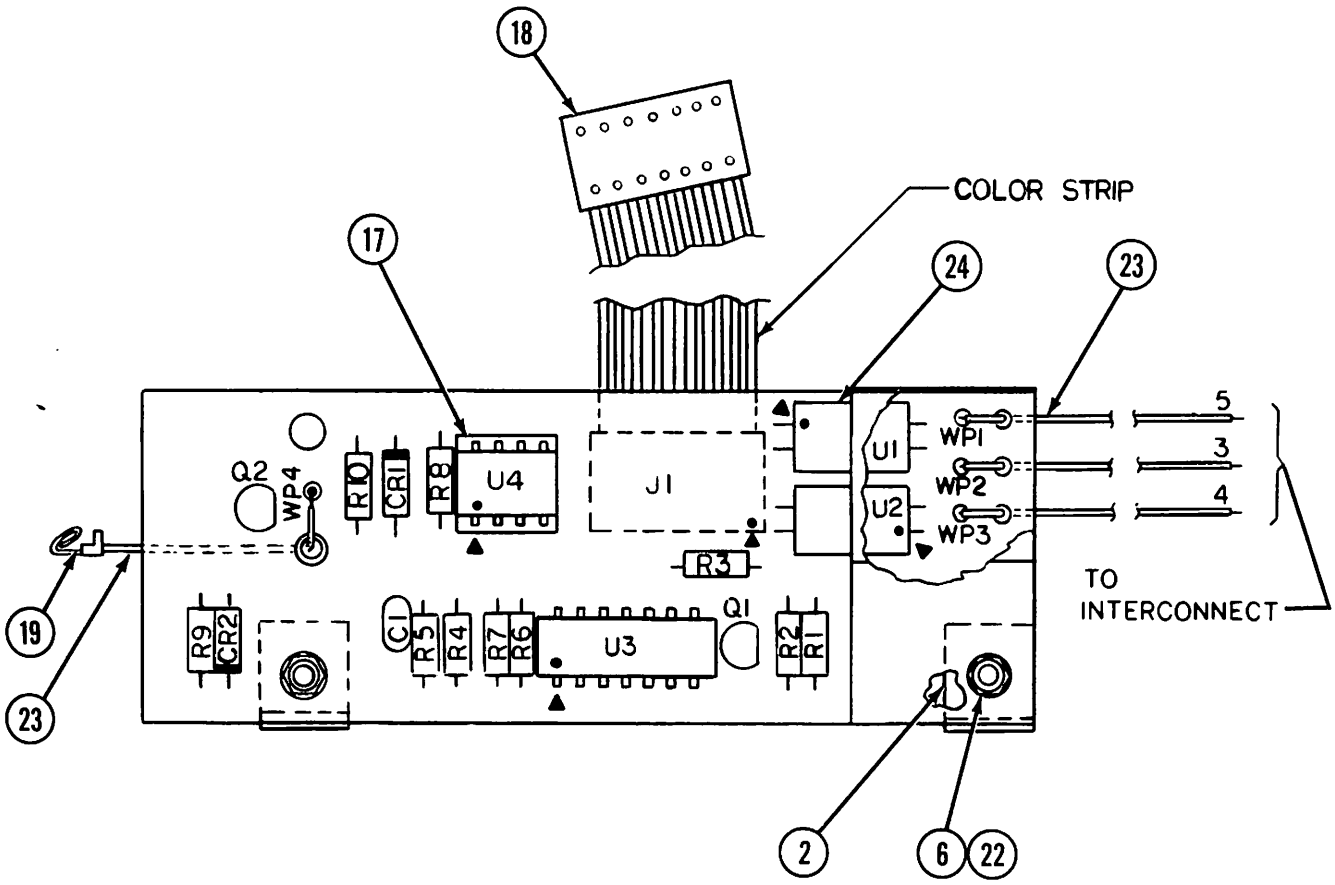


FIGURE 5-3. SYNCHRONIZER PCB ASSEMBLY

PARTS LIST

FIG AND ITEM NO.	REF. DES.	PCC PART NO.	DESCRIPTION	UNITS PER ASSY	USED ON CODE
5-3					
1		05-00308-02	SYNCHRONIZER PCB ASSY	REF	A
		05-00308-03	SYNCHRONIZER PCB ASSY, TUV	REF	B
2		800019-00	BRACKET, MOUNTING	2	
3	J1	800014-00	CABLE ASSY, FLAT	1	
4	C1	200507-019	CAPACITOR, DISC, 1000pF/1K	1	
5	CR1,2	200971-000	DIODE, 1N914B	2	
6		90-03006	HEXNUT, 4-40, SS	2	
7	U1,2	200876-000	I.C., LIN, CLA-7, 4P, OPTO ISO	2	A
		802054-00	I.C., LIN, CLA-7, HV/7KV OPTO ISO PRETEST	2	B
8	U3	02-14437-00	I.C., 74C00, QUAD NAND ATTENTION	1	
9	U4	02-14442-00	I.C., 2524, DIG, TTL, SHIFT	1	
10	R1	200470-062	RESISTOR, CF, 390, 1/4W, 5%	1	
11	R2	200470-087	RESISTOR, CF, 4.3K, 1/4W, 5%	1	
12	R3,6,7	200470-096	RESISTOR, CF, 10K, 1/4W, 5%	3	
13	R4	200470-120	RESISTOR, CF, 100K, 1/4W, 5%	1	
14	R5	200470-103	RESISTOR, CF, 20K, 1/4W, 5%	1	
15	R8	200470-083	RESISTOR, CF, 3K, 1/4W, 5%	1	
16	R9,10	200470-079	RESISTOR, CF, 2K, 1/4W, 5%	2	
17		200907-000	SOCKET, 8 PIN, IC DIP	1	
18		90-08027	TAPE, WEATHERSTRIP	A/R	
19	WP4	02-20369-00	TERMINAL, MINI SKT, 22-26	1	
20	Q1	200847-004	TRANSISTOR, PN3962, PNP	1	
21	Q2	200847-000	TRANSISTOR, EN2484, NPN	1	
22		90-04005	WASHER, LOCK, I.T., #4	2	
23		200357-166	WIRE, STRND, PVC, 300V, 26 AWG, YEL	A/R	
24		802172-00	SHIELD, NOMEX	1	B

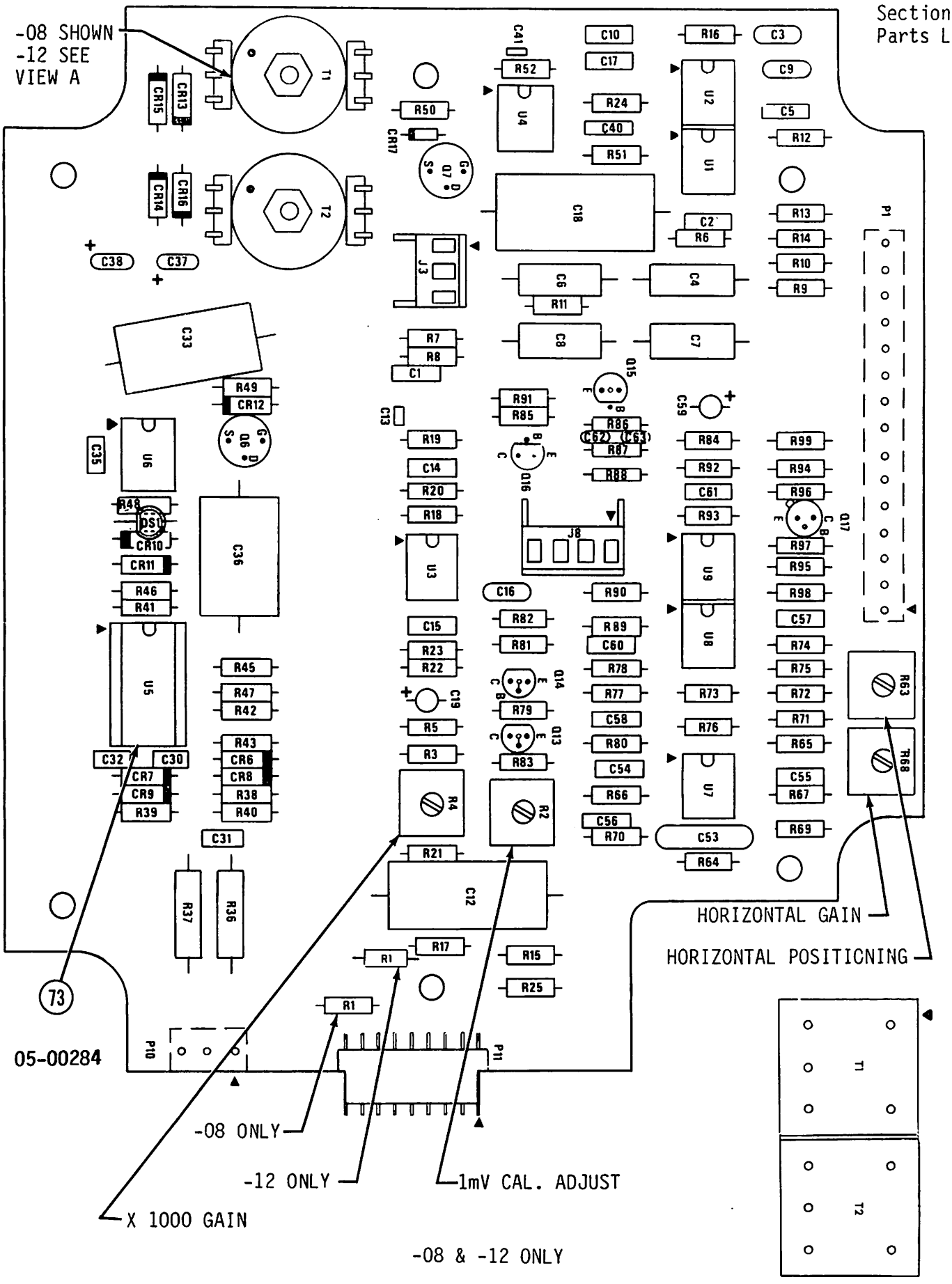


FIGURE 5-4. PREAMP PCB ASSEMBLY
(SHEET 1 OF 2)

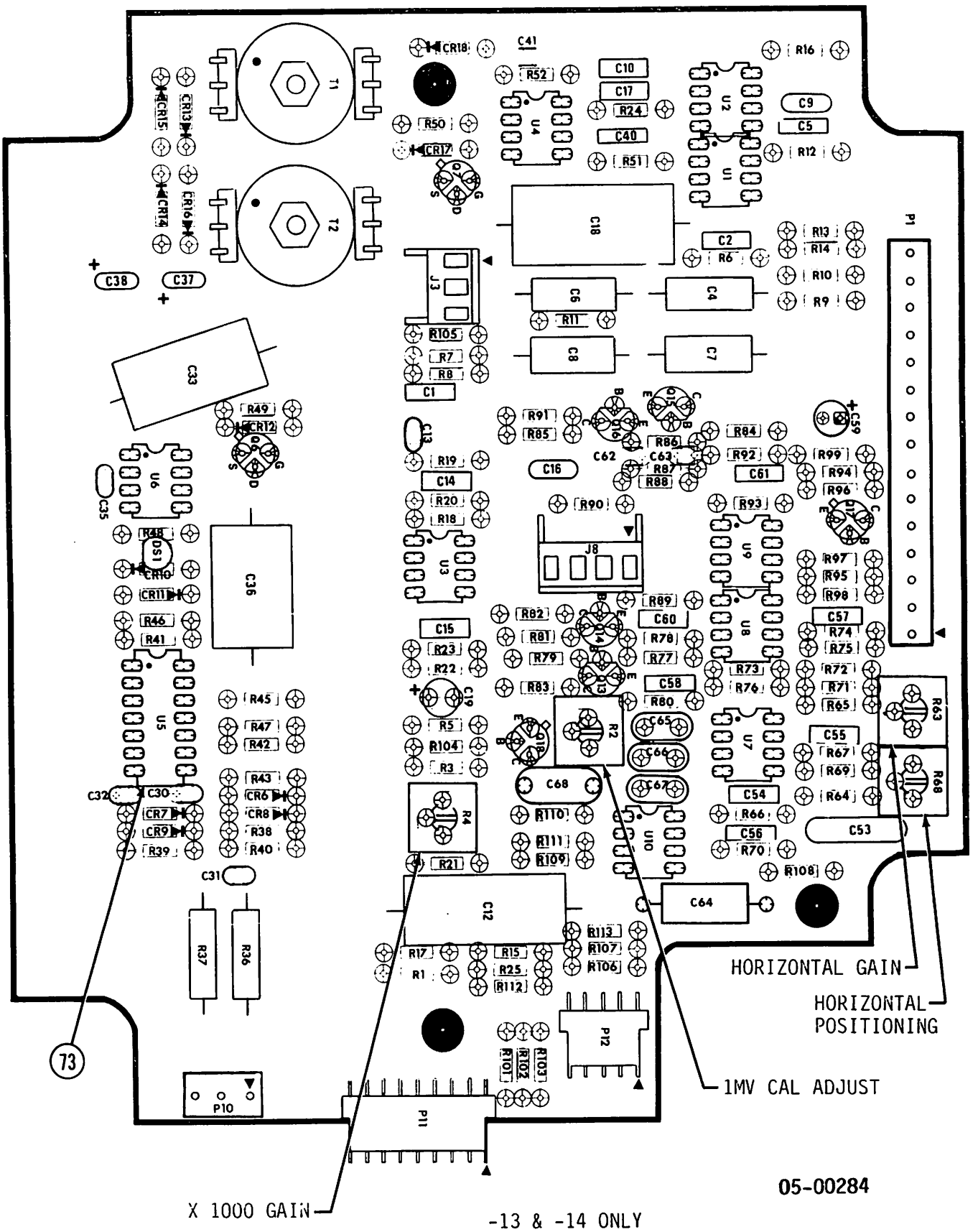


FIGURE 5-4. PREAMP PCB ASSEMBLY
(SHEET 2 OF 2)

PARTS LIST

FIG AND ITEM NO.	REF. DES.	PCC PART NO.	DESCRIPTION	UNITS PER ASSY	USED ON CODE
5-4					
1		05-00284-08	PREAMP PCB ASSY, 60HZ	REF	A
		05-00284-12	PREAMP PCB ASSY, 50HZ, TUV	REF	B
		05-00284-13	PREAMP PCB ASSY, 50HZ, C/R	REF	C
		05-00284-14	PREAMP PCB ASSY, 60HZ, C/R	REF	D
2	C1	200893-038	CAPACITOR, MONO, RAD, .22µF/50V, 10%	1	
3	C2	200901-225	CAPACITOR, MONO, RAD, 6800pF/100V,10%	1	
4	C3,9,16	200593-001	CAPACITOR, DISC, RAD, 100pF/1K, 10%	3	A,B
	C9,16	200593-001	CAPACITOR, DISC, RAD, 100pF/1K, 10%	2	C,D
5	C4,6, 7,8	02-12393-00	CAPACITOR, PS, WF, AXL, 3900pF/100V, 1%	4	A,D
	C4,6, 7,8	02-12394-00	CAPACITOR, PS, WF, AXL, 3950pF/200V, 10%	4	B,C
6	1.	200264-018	CAPACITOR, MONO, RAD, .1µF/50V, 20%	13	
7	C12,18, 33	200744-027	CAPACITOR, MF, PC, AXL, 5µF/50V, 5%	3	
8	C13	200893-062	CAPACITOR, MONO, RAD, 820pF/100V, 10%	1	
9	C19	02-12704-00	CAPACITOR, TANT, RAD, 47µF/20V, 10%	1	
10	C30,32	200901-091	CAPACITOR, MONO, RAD, 470pF/100V, 5%	2	
11	C31	200901-095	CAPACITOR, MONO, RAD, .001µF/100V, 5%	1	
12	C35,41	200264-010	CAPACITOR, MONO, RAD, .01µF/50V, 20%	2	
13	C36	02-12370-00	CAPACITOR, PE, WF, AXL, 1µF/100V, 10%	1	
14	C37,38	200922-000	CAPACITOR, TANT, RAD, 100µF/20V, 20%	2	
15	C53	200362-020	CAPACITOR, PE, FF, RAD,.047µF/100V, 10%	1	
16	C59	200500-048	CAPACITOR, TANT, RAD, 4.7µF/20V, 20%	1	
17	C62,63	200901-092	CAPACITOR, MONO, RAD, 560pF/100V, 5%	2	
18	C64	200744-157	CAPACITOR, MF, PC, AXL,.001µF/600V, 5%	1	C,D
19	C65,66, 67	200893-034	CAPACITOR, MONO RAD, .1µF/50V, 10%	3	C,D
20	C68	200893-050	CAPACITOR, MONO RAD, .2.2µF/50V, 10%	1	C,D
21	P1	200462-183	CONNECTOR, PLUG, WAFER, 15 PIN	1	

PARTS LIST

FIG AND ITEM NO.	REF. DES.	PCC PART NO.	DESCRIPTION	UNITS PER ASSY	USED ON CODE
5-4					
22	J3	200436-000	CONNECTOR, PLUG, 3 PIN	1	
23	J8	200436-001	CONNECTOR, PLUG, 4 PIN	1	
24	P10	200462-018	CONNECTOR, PLUG, WAFER, 3 PIN	1	
25	P11	200534-034	CONNECTOR, PLUG, WAFER, 9 PIN	1	
26	2.	200971-000	DIODE, FAST REC, 1N914B	10	A,B
		200971-000	DIODE, FAST REC, 1N914B	11	C,D
27	CR10,11	201272-000	DIODE, LOW LEAK, FDH300	2	
28	U1,2,3	200912-000	I.C., LIN OP-AMP, 308N	3	A,B
	U2,3	200912-000	I.C., LIN OP-AMP, 308N	2	C,D
29	U4,6	200254-000	I.C., J-FET OP-AMP, LF355N	2	A,B
	U1,4,6	200254-000	I.C., J-FET OP-AMP, LF355N	3	C,D
30	U5	802097-00	I.C., LIN IN-AMP, AD3641	1	
31	U7	02-14348-00	I.C., LIN OP-AMP, 741	1	
32	U8,9	201170-000	I.C., DUAL LIN OP-AMP, MC1458CP	2	
33	U10	200487-000	I.C., LIN OP-AMP, J-FET, LF353N	1	C,D
34	DS1	200491-000	LED, PNL MOUNT, RED	1	
35	R2,68	200504-009	POT, 10K, 1/2W, 20%, 1 TURN	2	
36	R4,63	200504-008	POT, 5K, 1/2W, 20%, 1 TURN	2	
37	3.	200470-096	RESISTOR, CF, 10K, 1/4W, 5%	6	A,B
		200470-096	RESISTOR, CF, 10K, 1/4W, 5%	8	C,D
38	R3	200470-052	RESISTOR, CF, 150, 1/4W, 5%	1	
39	R5	200470-091	RESISTOR, CF, 6.2K, 1/4W, 5%	1	
40	R6	200470-124	RESISTOR, CF, 150K, 1/4W, 5%	1	A,B
	R6,104	200470-124	RESISTOR, CF, 150K, 1/4W, 5%	2	C,D
41	R7,96	200470-088	RESISTOR, CF, 4.7K, 1/4W, 5%	2	
42	R8	200470-084	RESISTOR, CF, 3.3K, 1/4W, 5%	1	
43	R9,11	200054-464	RESISTOR, MF, 681K, 1/8W, 1%, RN55C	2	A,D
	R9,11	02-07564-00	RESISTOR, MF, 806K, 1/8W, 1%, RN60D	2	B,C
44	R10	200054-435	RESISTOR, MF, 340K, 1/8W, 1%, RN55C	1	A,D
	R10	200054-442	RESISTOR, MF, 402K, 1/8W, 1%, RN55C	1	B,C
45	R12,16	200470-032	RESISTOR, CF, 22, 1/4W, 5%	2	

PARTS LIST

FIG AND ITEM NO.	REF. DES.	PCC PART NO.	DESCRIPTION	UNITS PER ASSY	USED ON CODE
5-4					
46	R13	200470-074	RESISTOR, CF, 1.2K, 1/4W, 5%	1	
47	R14	200470-095	RESISTOR, CF, 9.1K, 1/4W, 5%	1	
48	R15,52	200470-168	RESISTOR, CF, 10M, 1/4W, 5%	2	
49	R17	200470-072	RESISTOR, CF, 1K, 1/4W, 5%	1	A,B
	R17,109, 112,113	200470-072	RESISTOR, CF, 1K, 1/4W, 5%	4	C,D
50	R18	200470-126	RESISTOR, CF, 180K, 1/4W, 5%	1	
51	R19	200470-146	RESISTOR, CF, 1.2M, 1/4W, 5%	1	
52	4.	200470-048	RESISTOR, CF, 100, 1/4W, 5%	11	
53	R22	200470-125	RESISTOR, CF, 160K, 1/4W, 5%	1	
54	R25	200054-193	RESISTOR, MF, 1K, 1/8W, 1%, RN55C	1	
55	R36,37	200850-288	RESISTOR, MF, 10K, 1/2W, 1%	2	
56	R38,40	200054-480	RESISTOR, MF, 1M, 1/8W, 1%, RN55C	2	
57	R39	200054-575	RESISTOR, MF, 10M, 1/8W, 1%, RN55C	1	
58	R41	200054-305	RESISTOR, MF, 15K, 1/8W, 1%, RN55C	1	
59	5.	200054-392	RESISTOR, MF, 121K, 1/8W, 1%, RN55C	5	
60	R43	200054-368	RESISTOR, MF, 68.1K, 1/8W, 1%, RN55C	1	
61	R45	200054-299	RESISTOR, MF, 13K, 1/8W, 1%, RN55C	1	
62	R46,48	200470-163	RESISTOR, CF, 6.2M, 1/4W, 5%	2	
63	R47,49, 50,94	200470-120	RESISTOR, CF, 100K, 1/4W, 5%	4	A,B
	6.	200470-120	RESISTOR, CF, 100K, 1/4W, 5%	8	C,D
64	R64	200470-144	RESISTOR, CF, 1M, 1/4W, 5%	1	A,B
	R64,105	200470-144	RESISTOR, CF, 1M, 1/4W, 5%	2	C,D
65	R65	200470-103	RESISTOR, CF, 20K, 1/4W, 5%	1	
66	R67,69	200470-100	RESISTOR, CF, 15K, 1/4W, 5%	2	
67	7.	200054-317	RESISTOR, MF, 20K, 1/8W, 1%, RN55C	8	
68	R72	200470-078	RESISTOR, CF, 1.8K, 1/4W, 5%	1	
69	R82,83, 86,87	200054-282	RESISTOR, MF, 8.66K, 1/8W, 1%, RN55C	4	
70	R95	200470-111	RESISTOR, CF, 43K, 1/4W, 5%	1	

PARTS LIST

FIG AND ITEM NO.	REF. DES.	PCC PART NO.	DESCRIPTION	UNITS PER ASSY	USED ON CODE
5-4					
71	R103	200470-123	RESISTOR, CF, 130K, 1/4W, 5%	1	C,D
72	R108	200470-107	RESISTOR, CF, 30K, 1/4W, 5%	1	C,D
73		200907-001	SOCKET, IC DIP, 14 PIN	1	
74	T1,2	02-18284-00	TRANSFORMER, PREAMP	2	A,C,D
	T1,2	802051-00	TRANSFORMER, ISOLATION, 60V, 15-30KHZ	2	B
75	Q6,7	200282-004	TRANSISTOR, NFET, VGS, 2N4393	2	
76	Q13,14, 15,16	201175-000	TRANSISTOR, NPN, VCEO, 2N5832	4	
77	Q17	200847-005	TRANSISTOR, PNP, VCEO, PN3962-18	1	
78	Q18	200942-001	TRANSISTOR, NPN, VCEO, PN2222A	1	C,D
79	P12	200534-030	CONNECTOR, PLUG, WAFER 5 PIN	1	C,D
		1.	C5,10,14,15,17,40,54-58,60,61		
		2.	CR6-9,CR12-17 CR6-9,CR12-18		
		3.	R1,21,75,77,90,98 R1,21,75,77,90,98,101,107		
		4.	R20,23,24,51,66,70,74,80,84,89,93		
		5.	R42,79,81,85,91		
		6.	R47,49,50,94,102,106,110,111		
		7.	R71,73,76,78,88,92,97,99		

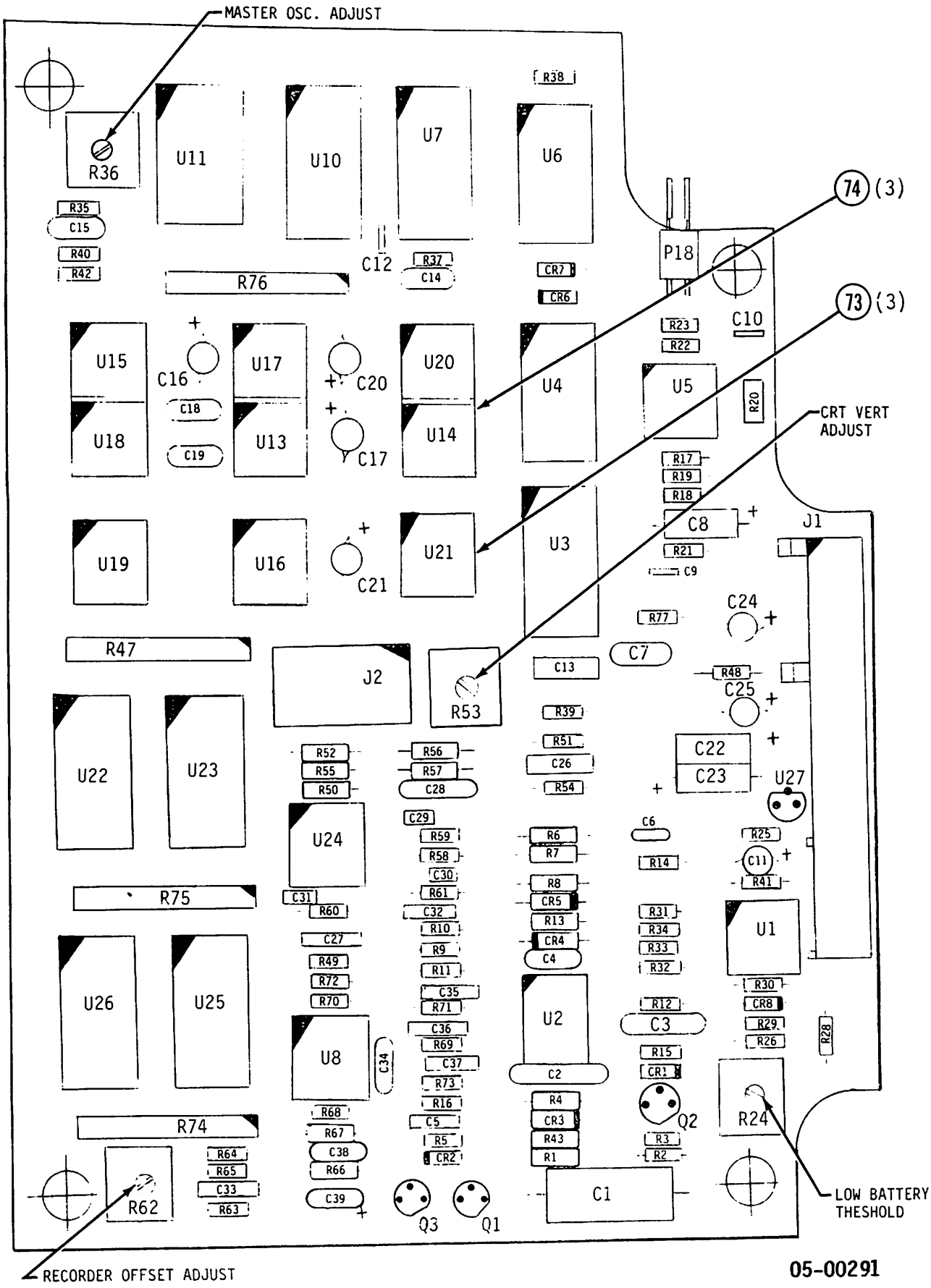


FIGURE 5-5. NO-FADE PCB ASSY

PARTS LIST

FIG AND ITEM NO.	REF. DES.	PCC PART NO.	DESCRIPTION	UNITS PER ASSY	USED ON CODE
5-5					
1		05-00291-07	NO-FADE PCB ASSY	REF	
2	C1	02-12370-00	CAPACITOR, PE MET, 1µF/100V, 10%	1	
3	C2	200362-004	CAPACITOR, PE, FF, 2200pF/100V, 10%	1	
4	C3	200362-020	CAPACITOR, PE, FF, .047µF/100V, 10%	1	
5	1.	200264-018	CAPACITOR, MONO, .1µF/50V, 20%	7	
6	C6	200893-038	CAPACITOR, MONO, .22µF/50V, 10%	1	
7	C7,15	200274-038	CAPACITOR, MICA, 330pF/500V, 5%	2	
8	C8	200546-147	CAPACITOR, TANT, 1µF/50V, 10%	1	
9	C9,10, 30,31	200264-020	CAPACITOR, MONO, .22µF/50V, 20%	4	
10	2.	200753-138	CAPACITOR, TANT, 4.7µF/20V, 20%	7	
11	C12	200901-201	CAPACITOR, MONO, 68pF/100V, 5%	1	
12	C13	200214-003	CAPACITOR, PE, 1800pF/50V, 5%	1	
13	C14	200865-027	CAPACITOR, DISC, 200pF/1K, 10%	1	
14	C18,19	200901-092	CAPACITOR, MONO, 560pF/50V, 5%	2	
15	C22,23	200546-016	CAPACITOR, TANT, 2.2µF/20V, 10%	2	
16	C27	200865-005	CAPACITOR, DISC, 10pF/1K, 10%	1	
17	C28	200274-040	CAPACITOR, MICA, 390pF/500V, 5%	1	
18	C29	200901-197	CAPACITOR, MONO, 33pF/50V, 5%	1	
19	C36	200893-036	CAPACITOR, MONO, .15µF/50V, 10%	1	
20	C37	200901-223	CAPACITOR, MONO, 4700pF/100V, 10%	1	
21	C38	200507-026	CAPACITOR, DISC, .005µF/1KV, 100%	1	
22	C39	200625-001	CAPACITOR, PC, 100µF/25V, 5%	1	
23	J1	02-20356-00	CONNECTOR, RCPT, WAFER, 15 PIN	1	
24	P18	200534-027	CONNECTOR, PLUG, WAFER, 2 PIN	1	
25	CR1-8	200971-000	DIODE, FAST RECOVRY, 1N914B	8	
26	U1	02-14409-00	I.C., DUAL OP-AMP, LM358N, DIP	1	
27	U2,8, 24	02-14405-00	I.C., DUAL OP-AMP, MC1458CP, DIP	3	
28	U3	200013-000	I.C., DUAL CMOS, 74C221N, DIP ATTENTION	1	
29	U4	200182-000	I.C., DUAL, FF/D, 4013B, DIP ATTENTION	1	
30	U5	02-14379-00	I.C., OP-AMP, DIP, LM748CN	1	

PARTS LIST

FIG AND ITEM NO.	REF. DES.	PCC PART NO.	DESCRIPTION	UNITS PER ASSY	USED ON CODE
5-5					
31	U6	200348-001	I.C., QUAD, NAND, 4011A ATTENTION	1	
32	U7,10	200714-000	I.C., BINARY CNTR, 4040B	2	
33	U11	02-14426-00	I.C., SCHMT, HEX INV, 74C14, DIP ATTENTION	1	
34	U13	02-14358-00	I.C., CLOCK DRIVER, DS0025CN, DIP	1	
35	U14-21	02-14442-00	I.C., TTL SHIFT, 2524, DIP	8	
36	U22,23	200677-000	I.C., CMOS BUFFER, 1410B, DIP ATTENTION	2	
37	U25,26	200897-000	I.C., QUAD D LATCH, 4042B ATTENTION	2	
38	U27	200933-000	I.C., VOLT REF, LM336	1	
39	R24	200504-009	POT, 10K, 1/2W, 20%, 1 TURN	1	
40	R36	200504-012	POT, 50K, 1/2W, 20%, 1 TURN	1	
41	R53,62	200504-010	POT, 20K, 1/2W, 20%, 1 TURN	2	
42	R1,37, 38	200470-107	RESISTOR, CF, 30K, 1/4W, 5%	3	
43	R2	200470-131	RESISTOR, CF, 300K, 1/4W, 5%	1	
44	R3	200470-115	RESISTOR, CF, 62K, 1/4W, 5%	1	
45	R4,5, 14	200470-120	RESISTOR, CF, 100K, 1/4W, 5%3		
46	3.	200470-096	RESISTOR, CF, 10K, 1/4W, 5%	5	
47	R7,11	200470-106	RESISTOR, CF, 27K, 1/4W, 5%	2	
48	4.	200470-118	RESISTOR, CF, 82K, 1/4W, 5%	6	
49	R12,15	200470-127	RESISTOR, CF, 200K, 1/4W, 5%	2	
50	5.	200470-048	RESISTOR, CF, 100, 1/4W, 5%	11	
51	R17,19	200054-288	RESISTOR, MF, 10K, 1/8W, 1%, RN55C	2	
52	R22	200470-144	RESISTOR, CF, 1M, 1/4W, 5%	1	
53	R25	200470-082	RESISTOR, CF, 2.7K, 1/4W, 5%	1	
54	R26	200054-343	RESISTOR, CF, 37.4K, 1/8W, 1%, RN55C	1	
55	R28	200054-299	RESISTOR, MF, 13K, 1/8W, 1%, RN55C	1	
56	R29	200470-168	RESISTOR, CF, 10M, 1/4W, 5%	1	
57	R30	200470-072	RESISTOR, CF, 1K, 1/4W, 5%	1	
58	R31-34, 64	200470-119	RESISTOR, CF, 91K, 1/4W, 5%	5	
59	R35	200470-086	RESISTOR, CF, 3.9K, 1/4W, 5%	1	

PARTS LIST

FIG AND ITEM NO.	REF. DES.	PCC PART NO.	DESCRIPTION	UNITS PER ASSY	USED ON CODE
5-5					
60	R40,42	200470-075	RESISTOR, CF, 1.3K, 1/4W, 5%	2	
61	R41	200470-054	RESISTOR, CF, 180, 1/4W, 5%	1	
62	R43	200470-088	RESISTOR, CF, 4.7K, 1/4W, 5%	1	
63	R47	200425-013	RESISTOR, NETWK, 9 x 6.8K, .2W, 2%	1	
64	R49,66, 67,72	200470-128	RESISTOR, CF, 220K, 1/4W, 5%	4	
65	R50,73	200470-129	RESISTOR, CF, 240K, 1/4W, 5%	2	
66	R52	200470-121	RESISTOR, CF, 110K, 1/4W, 5%	1	
67	R54	200470-104	RESISTOR, CF, 22K, 1/4W, 5%	1	
68	R57	200470-110	RESISTOR, CF, 39K, 1/4W, 5%	1	
69	R63	200470-117	RESISTOR, CF, 75K, 1/4W, 5%	1	
70	R65	200470-101	RESISTOR, CF, 16K, 1/4W, 5%	1	
71	R70,71	200470-108	RESISTOR, CF, 33K, 1/4W, 5%	2	
72	R74-76	02-11186-01	RESISTOR NETWK, LADDER, 10 PIN SIP	3	
73		200907-000	SOCKET, IC DIP, 8 PIN	3	
74		200907-002	SOCKET, IC DIP, 16 PIN	3	
75	J2	200033-000	SOCKET, IC DIP, 14 PIN	1	
76	Q1-3	02-14542-00	TRANSISTOR, NPN, EN2484	3	
		1.	C4,5,26,32-35		
		2.	C11,16,17,20,21,24,25		
		3.	R6,10,23,39,77		
		4.	R8,9,51,55,56,59		
		5.	R13,16,18,20,21,48,58,60,61,68,69		

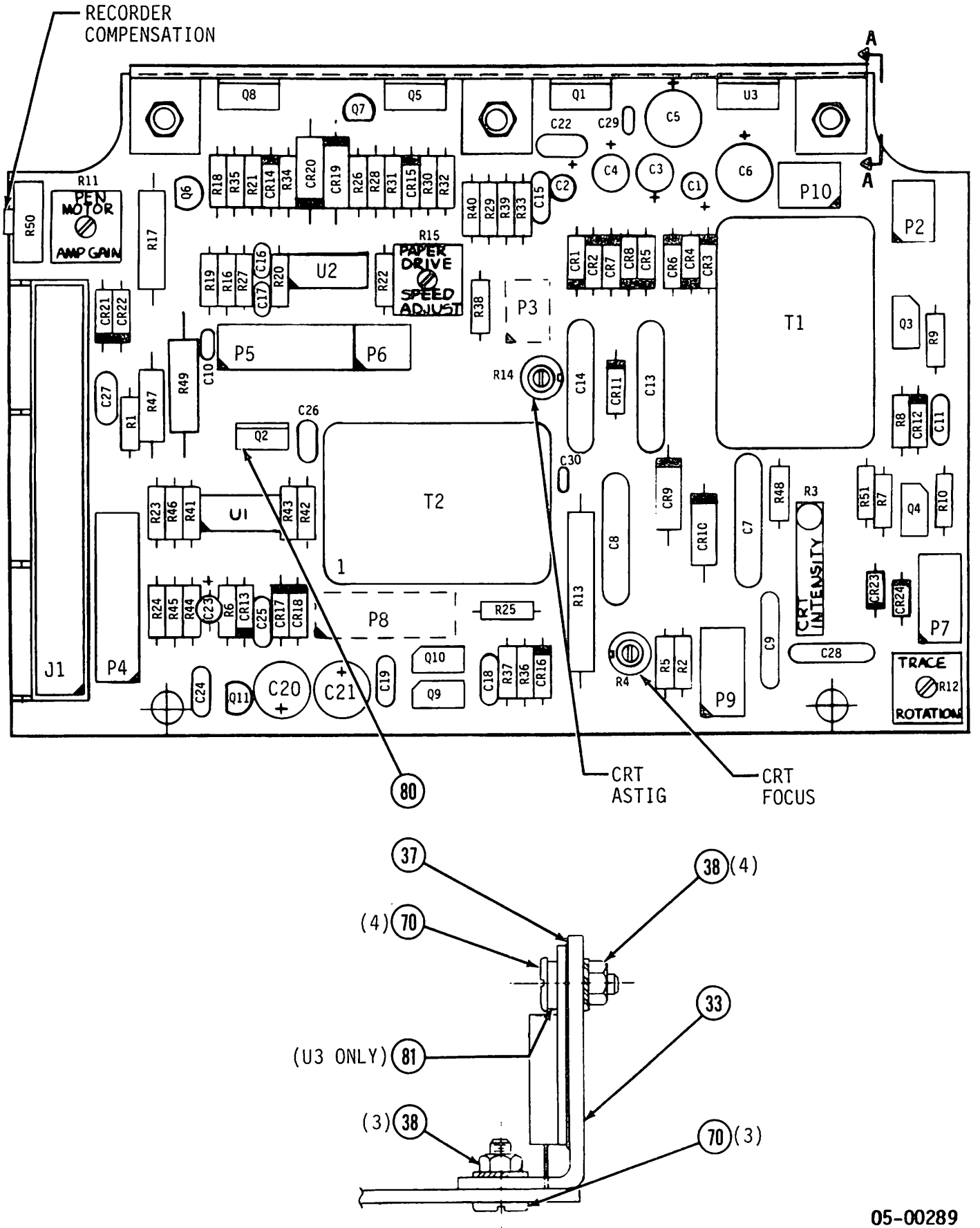


FIGURE 5-6. POWER SUPPLY AND RECORDER PCB ASSEMBLY

PARTS LIST

FIG AND ITEM NO.	REF. DES.	PCC PART NO.	DESCRIPTION	UNITS PER ASSY	USED ON CODE
5-6					
1		05-00289-03	POWER SUPPLY/RECORDER PCB ASSY	REF	
2	C1,2,23	200500-048	CAPACITOR, TANT, 4.7µF/20V, 20%	3	
3	C3,4	200280-053	CAPACITOR, TANT, 10µF/35V, 10%	2	
4	C5,20, 21	200922-000	CAPACITOR, TANT, 100µF/20V, 20%	3	
5	C6	200753-095	CAPACITOR, TANT, 220µF/10V, 20%	1	
6	C7,8, 28	200289-057	CAPACITOR, DISC, .005µF/3KV, 20%	3	
7	C9	200593-008	CAPACITOR, DISC, 470pF/1KV, 10%	1	
8	C10	200264-010	CAPACITOR, MONO, .01µF/50V, 20%	1	
9	C11	200507-008	CAPACITOR, DISC, .01µF/500V, +80%	1	
10	C13,14	200507-017	CAPACITOR, DISC, .05µF/500V, +80%	2	
11	C15,25	200264-018	CAPACITOR, MONO, .1µF/50V, 20%	2	
12	C16,17, 26	200264-020	CAPACITOR, MONO, .22µF/50V, 20%	3	
13	C18,19	200507-019	CAPACITOR, DISC, 1000pF/1K, 100%	2	
14	C22	200893-242	CAPACITOR, MONO, .47µf/50V, 22%	1	
15	C24	200593-001	CAPACITOR, DISC, 100pF/1K, 10%	1	
16	C27	200264-022	CAPACITOR, MONO, .47µF/50V, 22%	1	
17	C29,30	02-12082-00	CAPACITOR, MONO, 150pF/100V, 10%	2	
18	J1	02-20356-00	CONNECTOR, RECPT, WAFER, 15 PIN	1	
19	P2,10	200462-017	CONNECTOR, PLUG, WAFER, 2 PIN	2	
20	P3	200462-034	CONNECTOR, PLUG, WAFER, 2 PIN	1	
21	P4	200462-021	CONNECTOR, PLUG, WAFER, 6 PIN	1	
22	P5,6	200462-022	CONNECTOR, PLUG, WAFER, 7 PIN	2	
23	P7,9	200462-018	CONNECTOR, PLUG, WAFER, 3 PIN	2	
24	P8	200462-173	CONNECTOR, PLUG, WAFER, 5 PIN	1	
25	CR1-8	02-14155-00	DIODE, COMPUTER, UCD329	8	
26	CR9,10	200882-001	DIODE, FAST REC, 10S5F	2	
27	CR11	200658-007	DIODE, FAST REC, MR818	1	
28	CR12-16	200971-000	DIODE, FAST REC, 1N914B	5	
29	CR17,18	200658-002	DIODE, FAST REC, MR812	2	

PARTS LIST

FIG AND ITEM NO.	REF. DES.	PCC PART NO.	DESCRIPTION	UNITS PER ASSY	USED ON CODE
5-6					
30	CR19,20	200284-005	DIODE, POWER, 1N4385	2	
31	CR21,22	02-14100-00	DIODE, ZENER, 1N753A, .5W, 10%	2	
32	CR23,24	200605-017	DIODE, ZENER, 1N4745A, 1W, 5%	2	
33		01-41547-01	HEATSINK	1	
34	U1	02-14359-00	I.C., DIG TIMER, NE555	1	
35	U2	02-14405-00	I.C., DUAL OP-AMP, MC1458CP	1	
36	U3	200673-071	I.C., POS VOLT REG, MC7808CP	1	
37		90-09227	INSULATOR, SILIPAD	4	
38		90-03019	KEPNUT, #4-40, CP, CS	7	
39	R3	201166-019	POT, 5M, 1/2W, 20%, MULTI TURN	1	
40	R4,14	02-11579-00	POT, 5M, 1/2W, 10%, 1 TURN	2	
41	R11	200504-012	POT, 50K, 1/2W, 20%, 1 TURN	1	
42	R12,15	200504-009	POT, 10K, 1/2W, 20%, 1 TURN	2	
43	R50	200503-014	POT, 200K, 1/2W, 20%, 1 TURN	1	
44	R1,16	200470-104	RESISTOR, CF, 22, 1/4W, 5%	2	
45	R2	200470-128	RESISTOR, CF, 220K, 1/4W, 5%	1	
46	R5,6	200470-161	RESISTOR, CF, 5.1M, 1/4W, 5%	2	
47	R7,25	200470-072	RESISTOR, CF, 1K, 1/4W, 5%	2	
48	R8,9, 36,37, 51	200470-030	RESISTOR, CF, 18, 1/4W, 5%	5	
49	R10	200470-045	RESISTOR, CF, 75, 1/4W, 5%	1	
50	R13	02-09649-00	RESISTOR, MF, 66M, 1/2W, 5%	1	
51	R17	200676-013	RESISTOR, WW, 18, 3W, 5%	1	
52	R18	200470-099	RESISTOR, CF, 13K, 1/4W, 5%	1	
53	R19,44, 45,48	200470-120	RESISTOR, CF, 100K, 1/4W, 5%	4	
54	R20,22	200470-032	RESISTOR, CF, 22, 1/4W, 5%	2	
55	R21	200470-096	RESISTOR, CF, 10K, 1/4W, 5%	1	
56	R23	200470-102	RESISTOR, CF, 18K, 1/4W, 5%	1	
57	R24	200470-093	RESISTOR, CF, 7.5K, 1/4W, 5%	1	

PARTS LIST

FIG AND ITEM NO.	REF. DES.	PCC PART NO.	DESCRIPTION	UNITS PER ASSY	USED ON CODE
5-6					
58	R26, 28-30, 46	200470-048	RESISTOR, CF, 100, 1/4W, 5%	5	
59	R27,33	200470-079	RESISTOR, CF, 2K, 1/4W, 5%2		
60	R31,35	200470-064	RESISTOR, CF, 470, 1/4W, 5%	2	
61	R32,34	200470-004	RESISTOR, CF, 1.5, 1/4W, 5%	2	
62	R38	200470-126	RESISTOR, CF, 180K, 1/4W, 5%	1	
63	R39	200470-109	RESSITOR, CF, 36K, 1/4W, 5%	1	
64	R40	200470-007	RESISTOR, CF, 2, 1/4W, 5%	1	
65	R41	200470-113	RESISTOR, CF, 51K, 1/4W, 5%	1	
66	R42	200470-118	RESISTOR, CF, 82K, 1/4W, 5%	1	
67	R43	200470-100	RESISTOR, CF, 15K, 1/4W, 5%1		
68	R47	200471-048	RESISTOR, CF, 100, 1/2W, 5%	1	
69	R49	200676-026	RESISTOR, WW, 68, 3W, 5%	1	
70		200476-261	SCREW, 4-40 x 5/16, PH, S, CP, CS	7	
71	T1	02-18285-01	TRANSFORMER, MAIN PWR, 8VDC, 5%	1	
72	T2	02-18288-00	TRANSFORMER, RECORDER, 12VDC, 5%	1	
73	Q1,5	02-14624-00	TRANSISTOR, TIP29A, NPN	2	
74	Q2	02-14625-00	TRANSISTOR, TIP32A, PNP	1	
75	Q3,4, 9,10	02-14568-00	TRANSISTOR, D40D5, NPN	4	
76	Q6	02-14575-00	TRANSISTOR, 2N3904, NPN	1	
77	Q7	200847-005	TRANSISTOR, EN3962, PNP	1	
78	Q8	02-14623-00	TRANSISTOR, TIP30A, PNP	1	
79	Q11	02-14542-00	TRANSISTOR, EN2484, NPN	1	
80		200930-006	TUBING, HTSHRINK, 3/8 CLR	A/R	
81		02-35506-00	WASHER, SHOULDER, #4 NYLON	1	

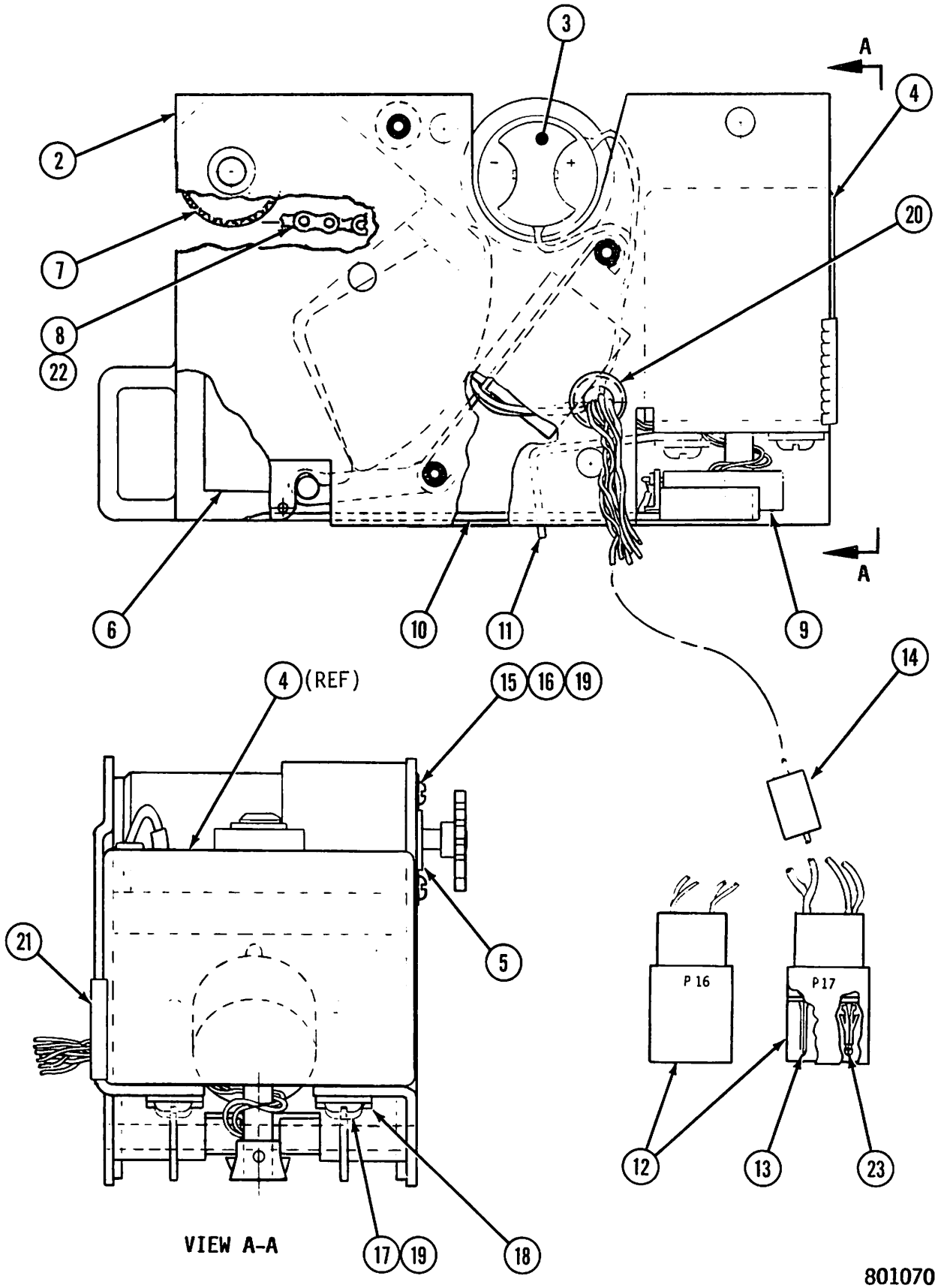


FIGURE 5-7. RECORDER ASSEMBLY

PARTS LIST

FIG AND ITEM NO.	REF. DES.	PCC PART NO.	DESCRIPTION	UNITS PER ASSY	USED ON CODE
5-7					
1		801070-01	RECORDER ASSEMBLY	REF	
2		801497-01	CHASSIS ASSY, RECORDER	1	
3		06-00117-01	DRIVE MOTOR ASSY	1	
4		800594-00	PEN MOTOR ASSY	1	
5		801055-00	WASHER, PAPER DRIVE	1	
6		802148-00	LABEL, RECORDER	1	
7		801103-00	SPROCKET, MODIFIED	1	
8		01-41504-01	DRIVE CHAIN	1	
9		800470-00	BLOCK, STYLUS	1	
10		02-28053-03	STYLUS, ADJUST	1	
11		01-41507-01	LIMIT, PEN MOTOR	2	
12	P16,17	200778-006	CONNECTOR, LOCK PLUG, 4 PIN	2	
13		200862-004	TERMINAL, PIN, CONN, M	1	
14		02-35456-00	FERRITE BEAD, INDUCTOR	8	
15		90-01190	SCREW, 2-56 x 3/16, PH, S, SS	3	
16		90-04001	WASHER, LOCK I.T. #2	3	
17		200476-570	SCREW, 6-32 x 3/8, PH, P, CP	4	
18		90-04053	WASHER, FLAT, SS #6	4	
19		90-09241	ADHESIVE, LOCTITE 271	A/R	
20		200872-000	BUSHING, SNAP-IN	1	
21		02-35189-00	GROMMET, CATERPILLAR	A/R	
22		90-09350	LUBRICANT, GEN PURPOSE	A/R	
23		200862-010	TERMINAL, PIN, CONN, M	6	

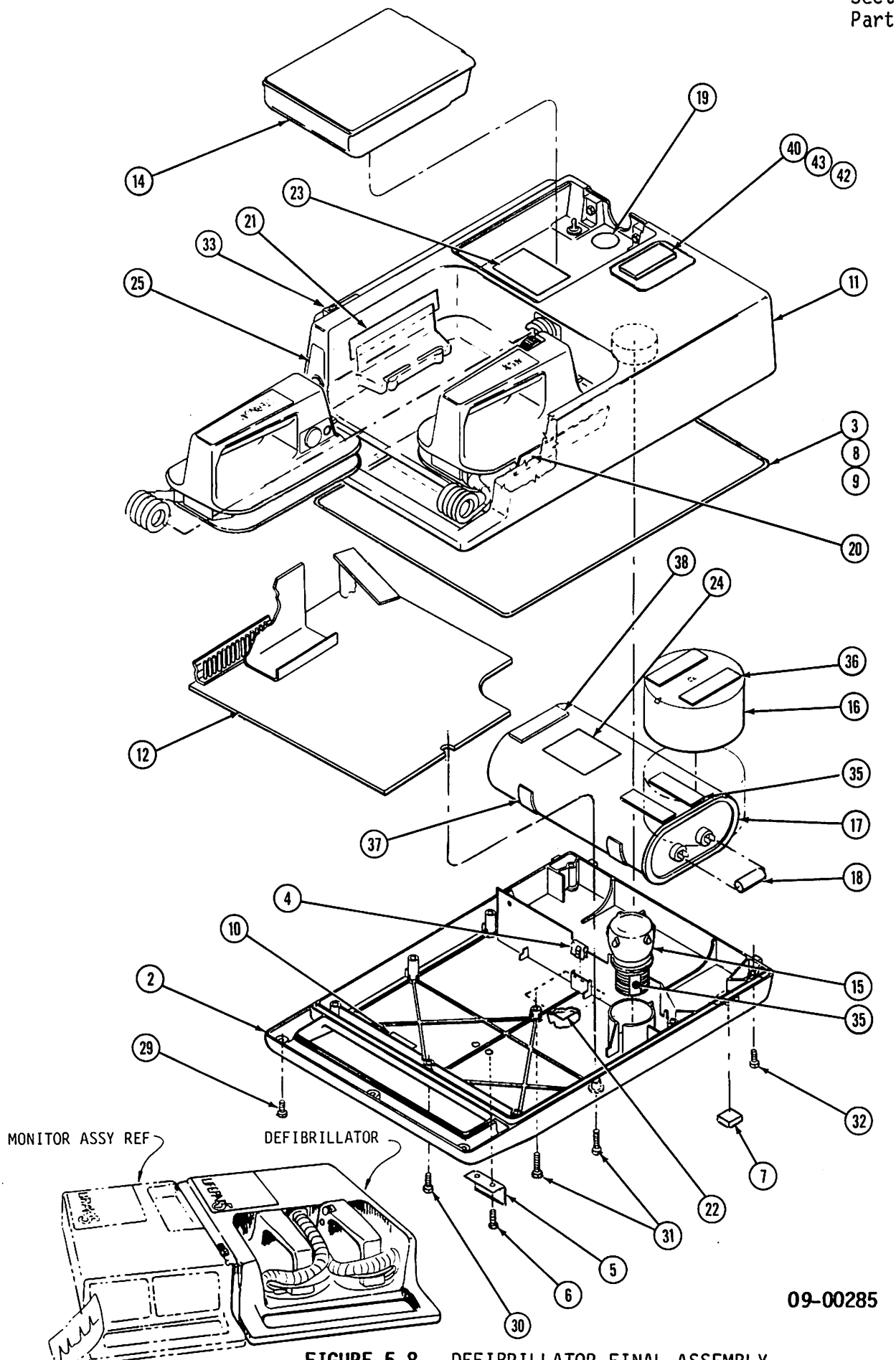


FIGURE 5-8. DEFIBRILLATOR FINAL ASSEMBLY
(SHEET 1 OF 2)

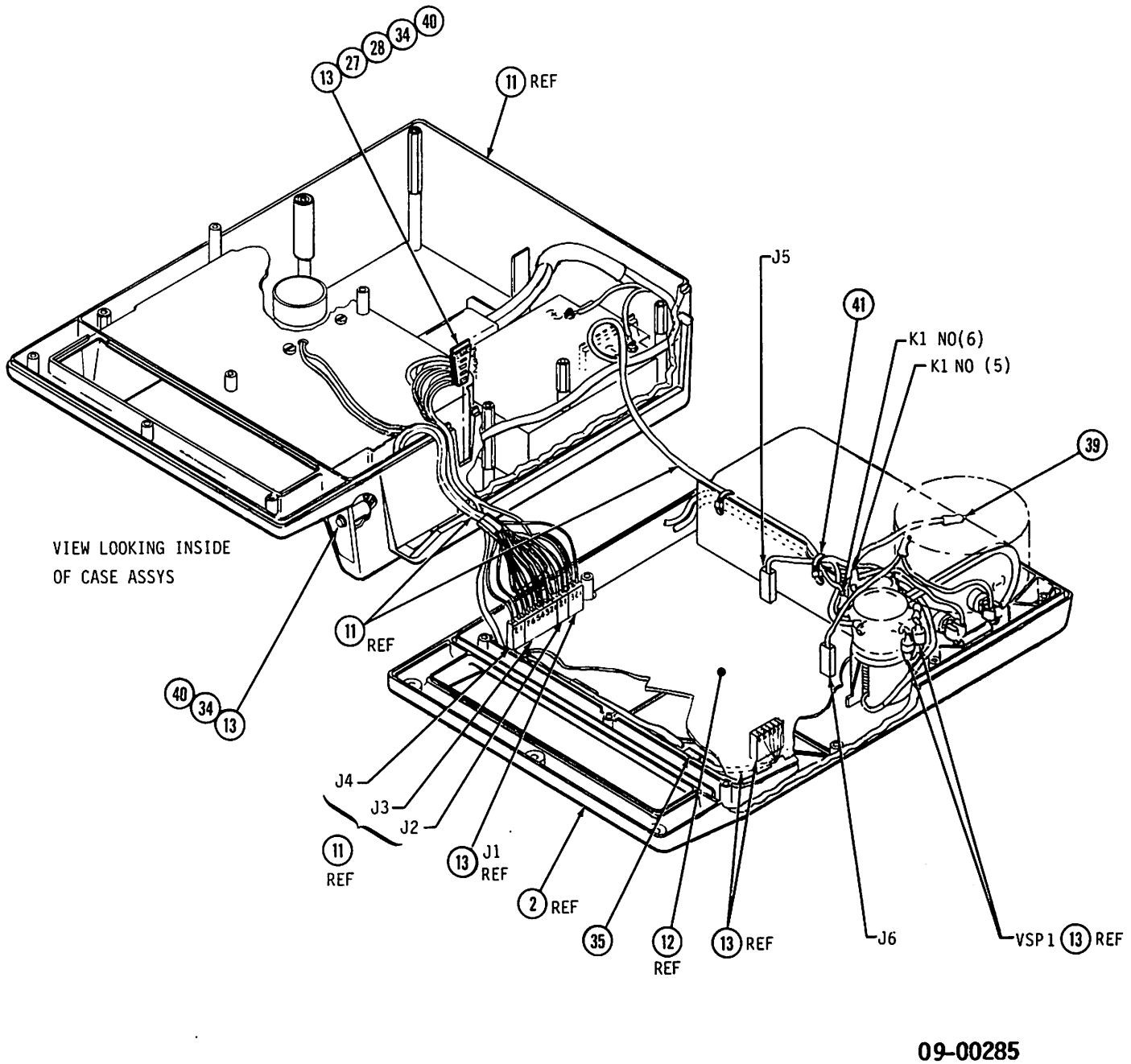


FIGURE 5-8. DEFIBRILLATOR FINAL ASSEMBLY
(SHEET 2 OF 2)

PARTS LIST

FIG AND ITEM NO.	REF. DES.	PCC PART NO.	DESCRIPTION	UNITS PER ASSY	USED ON CODE
5-8					
1		09-00285-08	DEFIBRILLATOR FINAL ASSY, LP/5	REF	A
		09-00285-11	DEFIBRILLATOR FINAL ASSY, LP/5, ENGLISH, TUV	REF	B
		09-00285-12	DEFIBRILLATOR FINAL ASSY, LP/5, ENGLISH, CSA	REF	C
		801528-00	DEFIBRILLATOR FINAL ASSY, LP/5, FRENCH, CSA	REF	D
		801528-02	DEFIBRILLATOR FINAL ASSY, LP/5, GERMAN, TUV	REF	E
		801508-04	DEFIBRILLATOR FINAL ASSY, LP/5, FRENCH, TUV	REF	F
		801528-05	DEFIBRILLATOR FINAL ASSY, LP/5, SPANISH, TUV	REF	G
2		801928-00	CASE ASSY, LOWER	1	
3		01-41545-00	PERIMETER SEAL	1	
4		02-35474-00	FASTENER CLIP, PCB	3	
5		800222-01	FASTENER, CLIP, BAIL	1	
6	1.	200531-000	SCREW, 4-24 X 3/16, PH, P, CS, CP, STP	2	
7		02-35246-00	FOOT, STICK-ON, BLK	4	
8		90-09255	LOCTITE, 415, SUPERBOND	A/R	
9		90-09035	RTV, 102 WHT	A/R	
10		90-08006	TAPE, DOUBLE STICK, 1/2" W	A/R	
11		06-00127-10	UPPER CASE ASSY, COMPONENTS	1	A,C
		06-00127-11	UPPER CASE ASSY, COMPONENTS, INT'L	1	B,D,E, F,G
12		05-00286-10	MAIN PCB ASSY, DEFIB	1	A,C
		05-00286-11	MAIN PCB ASSY, DEFIB, TUV	1	B,D,E, F,G
13		04-50081-04	WIRE HARNESS ASSY, DEFIB SYNC	1	A,C
		04-50081-05	WIRE HARNESS ASSY, DEFIB SYNC	1	B,D,E, F,G

PARTS LIST

FIG AND ITEM NO.	REF. DES.	PCC PART NO.	DESCRIPTION	UNITS PER ASSY	USED ON CODE
5-8					
14		09-10424-02	BATTERY PAK ASSY	1	
15	K3	801709-00	TRANSFER RELAY, DPDT, CSA, 7.5KV, 30A	1	A,C
		802052-00	TRANSFER RELAY, DPDT, 7.5KV, PRETEST	1	B,D,E, F,G
16	L2	02-18024-01	INDUCTOR, 36.3mH, 55A, CSA	1	
17	C1	800186-00	CAPACITOR, LYTIC, 42μF/5KV, CSA	1	
18	R1	800516-02	RESISTOR ASSEMBLY	1	A,C
19		200795-000	LABEL, CLA APPROVAL	1	A
20		01-50315-06	LABEL, CAUTION, HAZARD	1	A,B,D
21		01-50316-06	LABEL, DANGER	1	A,B,C
22		01-50318-04	LABEL, CAUTION, SHOCK, ENG	1	A,B,C
23		801518-00	LABEL, SERIAL NO.	1	A,B
		801518-01	LABEL, SERIAL NO., CSA	1	C
24		801533-00	LABEL, HI VOLTAGE, INTERNATIONAL	1	
25		800021-06	LABEL, SYNC	1	A,B,C
26		800360-07	LABEL, CSA WARNING	1	C
27		02-35531-00	GREASE, LUBE, LITHIUM, WHT	A/R	
28		90-09034	GREASE, LUBE, SILICONE	A/R	
29		02-35529-01	SCREW, 4-40 x 5/16, PH, S, SS, O/R SEAL	3	
30		02-35530-04	SCREW, 6-32 x 1/2, PH, S, SS, O/R SEAL	1	
31		02-35530-00	SCREW, 6-32 x 3/4, PH, S, SS, O/R SEAL	2	
32		02-35530-02	SCREW, 6-32 x 1.0, PH, S, SS, O/R SEAL	7	
33		201173-315	SCREW, 4-40 X 7/16, ST, K, CS	1	B,E, F,G
34		90-09035	SEALANT, RTV 102, WHT	A/R	
35		90-08006	TAPE, DBL BACK, 1/2	A/R	
36		90-08029	TAPE, FOAM, 3/4 x 1/8	A/R	
37		90-08036	TAPE, ADHESIVE, 1/2	A/R	
38		90-08027	TAPE, WEATHERSTRIP, 3/4	A/R	

PARTS LIST

FIG AND ITEM NO.	REF. DES.	PCC PART NO.	DESCRIPTION	UNITS PER ASSY	USED ON CODE
5-8					
39		200283-019	TUBE, SHRINK, 1/4 BLK	A/R	
40		90-09251	RTV PRIMER 4179, SEALANT	A/R	
41		90-10011	TIEWRAP, NYLON, MIN	A/R	
42		801659-04	LABEL, ENERGY METER	1	B
43		801674-00	ENERGY METER ASSY, INT'L	1	B,D,E, F,G
44	*	801451-04	LABEL ASSY KIT, DEFIB, SPANISH	1	
		01-50318-07	LABEL, CAUTION, SHOCK	1	G
		01-50316-09	LABEL, CAUTION, EXPLOSION	1	G
	2.	01-5018-00	LABEL, SERIAL NUMBER	1	G
		800021-09	LABEL, SYNC	1	G
		01-50315-05	LABEL, CAUTION, HAZARD, ELECT, OUTPUT	1	G
		801659-02	LABEL, ENERGY METER	1	G
45		801452-06	DEFIB, LABEL ASSY KIT, FRENCH, CSA	1	D
		801452-08	DEFIB, LABEL ASSY KIT, FRENCH	1	F
		01-50318-05	LABEL, CAUTION, SHOCK	1	D,F
		01-50316-07	LABEL, DANGER, EXPLOSION	1	D,F
		801518-02	LABEL, SERIAL NUMBER, FRENCH, CSA	1	D
	3.	801518-03	LABEL, SERIAL NUMBER, FRENCH	1	F
		800021-07	LABEL, SYNC, FRENCH	1	D,F
		01-50315-07	LABEL, CAUTION, HAZARD, ELECT, OUTPUT	1	D,F
		800360-07	LABEL, WARNING, CSA	1	D
		801659-01	LABEL, ENERGY METER	1	F
46		801453-03	DEFIB, LABEL ASSY KIT, GERMAN	1	E
		01-50318-06	LABEL, CAUTION, SHOCK	1	E
		01-50316-08	LABEL, DANGER, EXPLOSION	1	E
		801518-04	LABEL, SERIAL NUMBER	1	E
	4.	800021-08	LABEL, SYNC	1	E
		01-50315-08	LABEL, CAUTION, HAZARD, ELECT OUTPUT	1	E
		801659-03	LABEL, ENERGY METER, GERMAN	1	E

PARTS LIST

FIG AND ITEM NO.	REF. DES.	PCC PART NO.	DESCRIPTION	UNITS PER ASSY	USED ON CODE
5-8					
		*	ITEMS 44-46 NOT SHOWN ON DRAWINGS.		
		1.	PART OF ITEM 2, 801928		
		2.	PART OF ITEM 44, 801451.		
		3.	PART OF ITEM 45, 801452		
		4.	PART OF ITEM 46, 801453.		

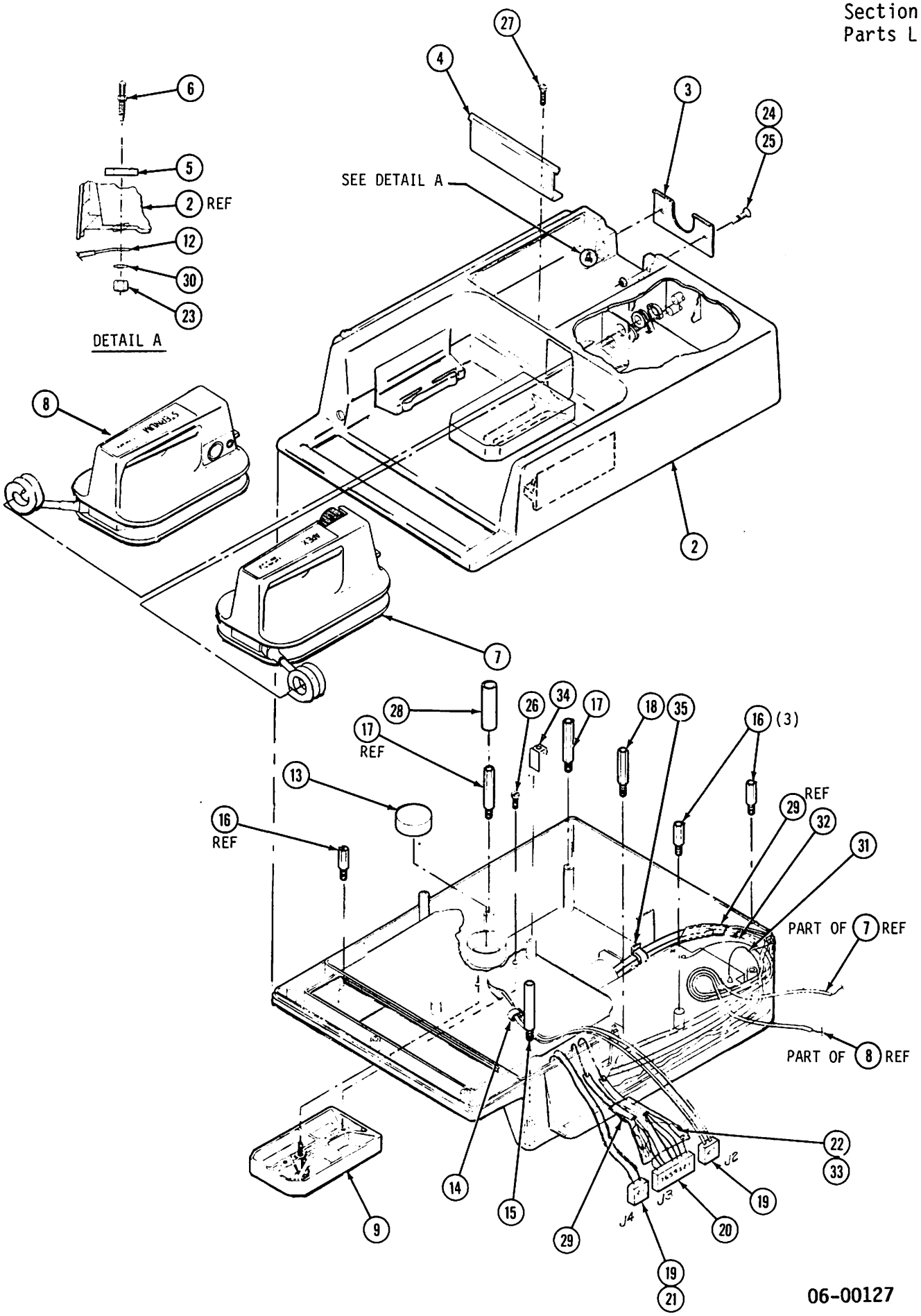


FIGURE 5-9. UPPER CASE ASSY, DEFIB COMPONENTS

PARTS LIST

FIG AND ITEM NO.	REF. DES.	PCC PART NO.	DESCRIPTION	UNITS PER ASSY	USED ON CODE
5-9					
1		06-00127-10	UPPER CASE ASSY, DEFIB COMPONENTS	REF	A
		06-00127-11	UPPER CASE ASSY, DEFIB COMP, INT'L	REF	B
2		06-00120-05	UPPER CASE ASSY	1	A
		06-00120-06	UPPER CASE ASSY	1	B
3		01-41528-00	PLATE LATCH	1	
4		01-41540-01	RETAINER, BATTERY PAK	1	
5		01-41542-00	SEAL, BATTERY PAK	2	
6		201171-000	CONNECTOR, BANANA PLUG, MINI	2	
7		801271-XX	PADDLE ASSY, APEX	1	
8	1.	801271-XX	PADDLE ASSY, STERNUM	1	
9		06-00125-01	RETAINER, CENTER PADDLE ASSY	1	
10			DELETED		
11			DELETED		
12		90-06072	TERMINAL LUG, #4 RING, RED	1	
13		01-41544-01	PAD, SPACER	1	
14		90-10046	RETAINER, WIRE CLIP	1	
15		801892-00	STANDOFF, M/F, AL HEX, 6/32 x 2.0	1	
16		02-35471-00	STANDOFF, M/F, AL HEX, 6-32 x 1.0	3	
17		02-35471-01	STANDOFF, M/F, AL HEX, 6-32 x 1.5	2	
18		02-35471-02	STANDOFF, M/F, AL HEX, 6-32 x 2.0	1	
19	J2,4	200277-000	CONNECTOR, RECPT, HOUSING, 2 PIN	2	
20	J3	200277-005	CONNECTOR, RECPT, HOUSING, 7 PIN	1	
21		02-20241-00	TERMINAL, CRIMP SKT, #18-24	2	
22		90-10051	TERMINAL, WINDOW SPLICE, YEL	2	
23		90-03001	NUT, HEX, 4-40 x 3/16, CP, CS	2	
24		90-03019	KEPNUT, 4-40 x 1/4, CP, CS	2	
25		90-01195	SCREW, 4-40 x 5/16, FH, P, SS, NYLOK	2	
26		02-35529-02	SCREW, 4-40 x 1/2, PH, S, SS, LOCK	2	
27		200531-012	SCREW, 6-19 x 1/4, PH, S, CP, S/TAP	2	
28		200283-020	TUBING, HEATSHRINK, BLK, 3/8	A/R	

PARTS LIST

FIG AND ITEM NO.	REF. DES.	PCC PART NO.	DESCRIPTION	UNITS PER ASSY	USED ON CODE
5-9					
29		200283-021	TUBING, HEATSHRINK, BLK, 1/2	A/R	
30		90-04005	WASHER, LOCK I.T., #4 SS	2	
31		200357-055	WIRE, STRND, PVC, 300V, CSA, #18 BLK	A/R	
32		200357-056	WIRE, STRND, PVC, 300V, CSA, #18 RED	A/R	
33		200357-171	WIRE, STRND, PVC, 300V, CSA, #26 VIO	A/R	
34		800814-04	INSULATOR, THERM CONDUCTIVE	1	
35		90-10011	RETAINER, CABLE TIE	1	
		1.	SEE FIGURE 5-12 FOR PARTS BREAKDOWN, FOR ITEMS 7 & 8.		

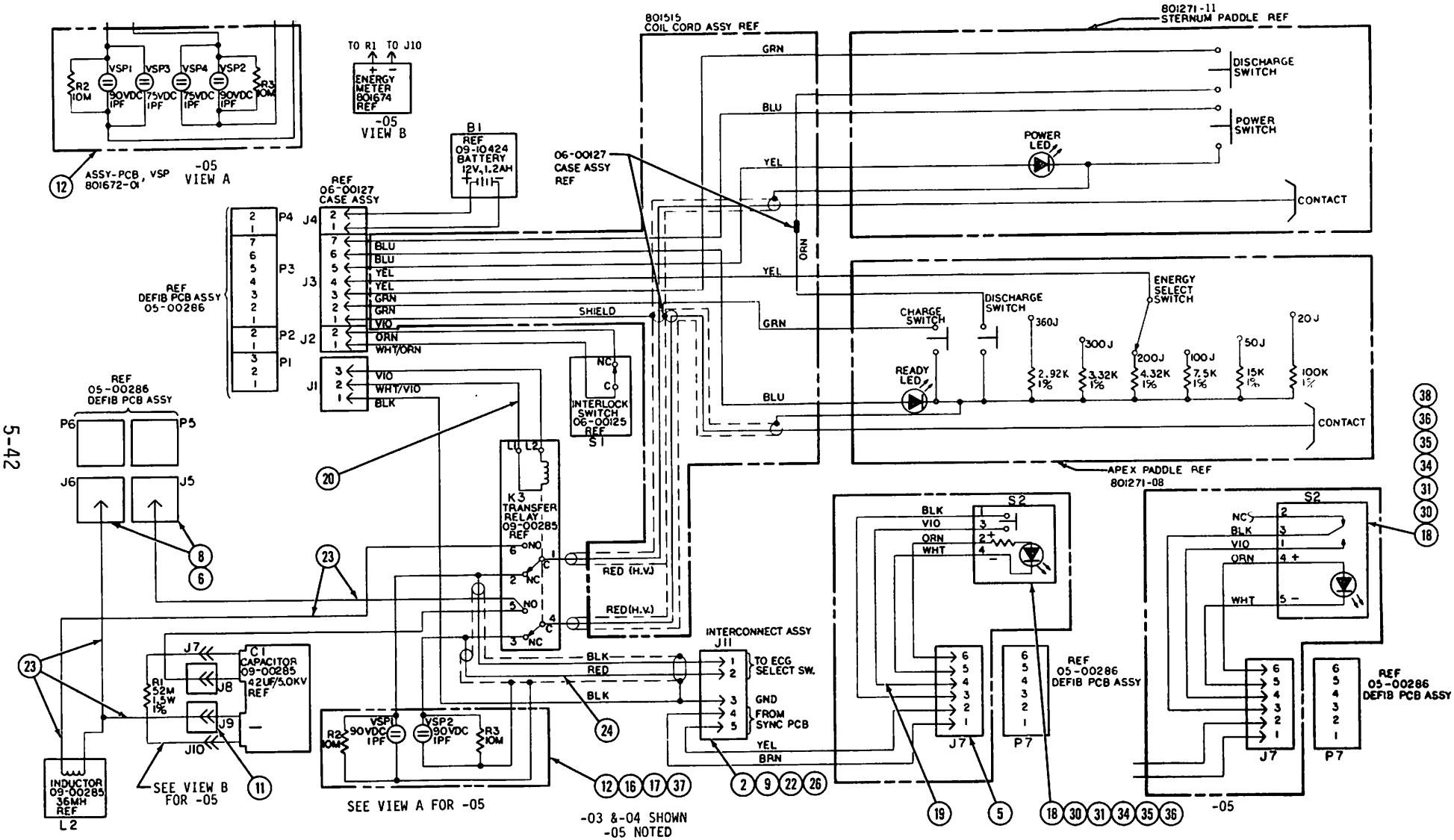


FIGURE 5-10. DEFIB WIRE HARNESS ASSY

PARTS LIST

FIG AND ITEM NO.	REF. DES.	PCC PART NO.	DESCRIPTION	UNITS PER ASSY	USED ON CODE
5-10					
1		04-50081-03	DEFIB WIRE HARNESS ASSY - STANDARD	REF	A
		04-50081-04	DEFIB WIRE HARNESS ASSY - SYNC, DOM	REF	B
		04-50081-05	DEFIB WIRE HARNESS ASSY - SYNC, INT'L	REF	C
2		200530-000	CABLE CLAMP, D-TYPE	1	
3	J1	200277-001	CONNECTOR, 3 PIN, HSNG, RCPT	1	
4	J7	200277-004	CONNECTOR, 6 PIN, HSNG, RCPT	1	B,C
5		200390-016	CONTACT, CRIMP, TERMNL, 18-24	3	A
		200390-016	CONTACT, CRIMP, TERMNL, 18-24	9	B,C
6	J5,6	90-06053	TERMINAL, HSNG, SLIP-ON, LUG	2	
7	J11	06-00115-02	INTERCONNECT ASSY	1	
8		90-06063	TERMINAL, LUG, SLIP-ON	2	
9		02-35535-00	PUSHNUT, #4, RND, AL	1	
10	S2	200005-000	SWITCH, INDICATOR, PUSH/B, RED	1	B
		201264-000	SWITCH, INDICATOR, PUSH/B, RED	1	C
11	J8,9	200514-000	TERMINAL, QK DISCONN, RT ANGLE, 18-22 AWG	2	
12		801672-00	PCB ASSY, VOLTAGE SURGE PROTECTOR, DOMES	1	A,B
		801672-01	PCB ASSY, VOLTAGE SURGE PROTECTOR, INT'L	1	C
13	VSP3,4	200324-00	VSP, 75 VDC, 1pF (USED ON 811672-01 PCB ONLY)	2	
	1.				
14	VSP1,2	200324-01	VSP, 90 VDC, 1pF	2	
15	R1,2	200468-168	RESISTOR, CC, 10M, 1/4W,5%	2	
16		200357-109	WIRE, STRND, PVC, 300V #22, CSA, BLK	A/R	
17		200357-110	WIRE, STRND, PVC, 300V, #22, CSA, RED	A/R	
18		200283-017	TUBING, HT/SHRINK 1/8 BLK	A/R	
19		90-07020	TUBING, #4, PVC, 105 CLEAR	A/R	B,C
20		90-07022	TUBING, #8, PVC, 105 CLEAR	A/R	
21		200624-005	TUBING, TEFLON, #20, CLEAR	A/R	
22		90-09035	SEALANT-RTV, WHITE	A/R	

PARTS LIST

FIG AND ITEM NO.	REF. DES.	PCC PART NO.	DESCRIPTION	UNITS PER ASSY	USED ON CODE
5-10					
23		200405-020	CABLE, UNSHLD, STRND, 1 COND	A/R	
24		200404-042	CABLE, SHLD, STRND, 2 COND	A/R	
25		200357-055	WIRE, STRND, PVC, 300V, 18 AWG, BLK, CSA	A/R	
26		200357-056	WIRE, STRND, PVC, 300V, 18 AWG, RED, CSA	A/R	
27		200357-109	WIRE, STRND, PVC, 300V, 22 AWG, BLK, CSA	A/R	
28		200357-117	WIRE, STRND, PVC, 300V, 22 AWG, VIO, CSA	A/R	
29		200357-126	WIRE, STRND, PVC, 300V, 22 AWG, WHT/VIO, CSA	A/R	
30		200357-162	WIRE, STRND, PVC, 300V, 26 AWG, WHT, CSA	A/R	B
31		200357-163	WIRE, STRND, PVC, 300V, 26 AWG, BLK, CSA	A/R	B
32		200357-166	WIRE, STRND, PVC, 300V, 26 AWG, YEL, CSA	A/R	B
33		200357-168	WIRE, STRND, PVC, 300V, 26 AWG, BRN, CSA	A/R	B
34		200357-171	WIRE, STRND, PVC, 300V, 26 AWG, VIO, CSA	A/R	B
35		200357-169	WIRE, STRND, PVC, 300V, 26 AWG, ORN, CSA	A/R	B
36		90-10055	RETAINER-CABLE, TIE, NYLON	2	B,C
		90-10055	RETAINER-CABLE, TIE, NYLON	1	A
37		201340-000	SEALANT, CONFORMAL COATING	A/R	
38		90-09262	ADHESIVE, HOT STUFF INSTANT	A/R	C
		1.	PART OF ITEM 12, 801672 VSP PCB ASSY		

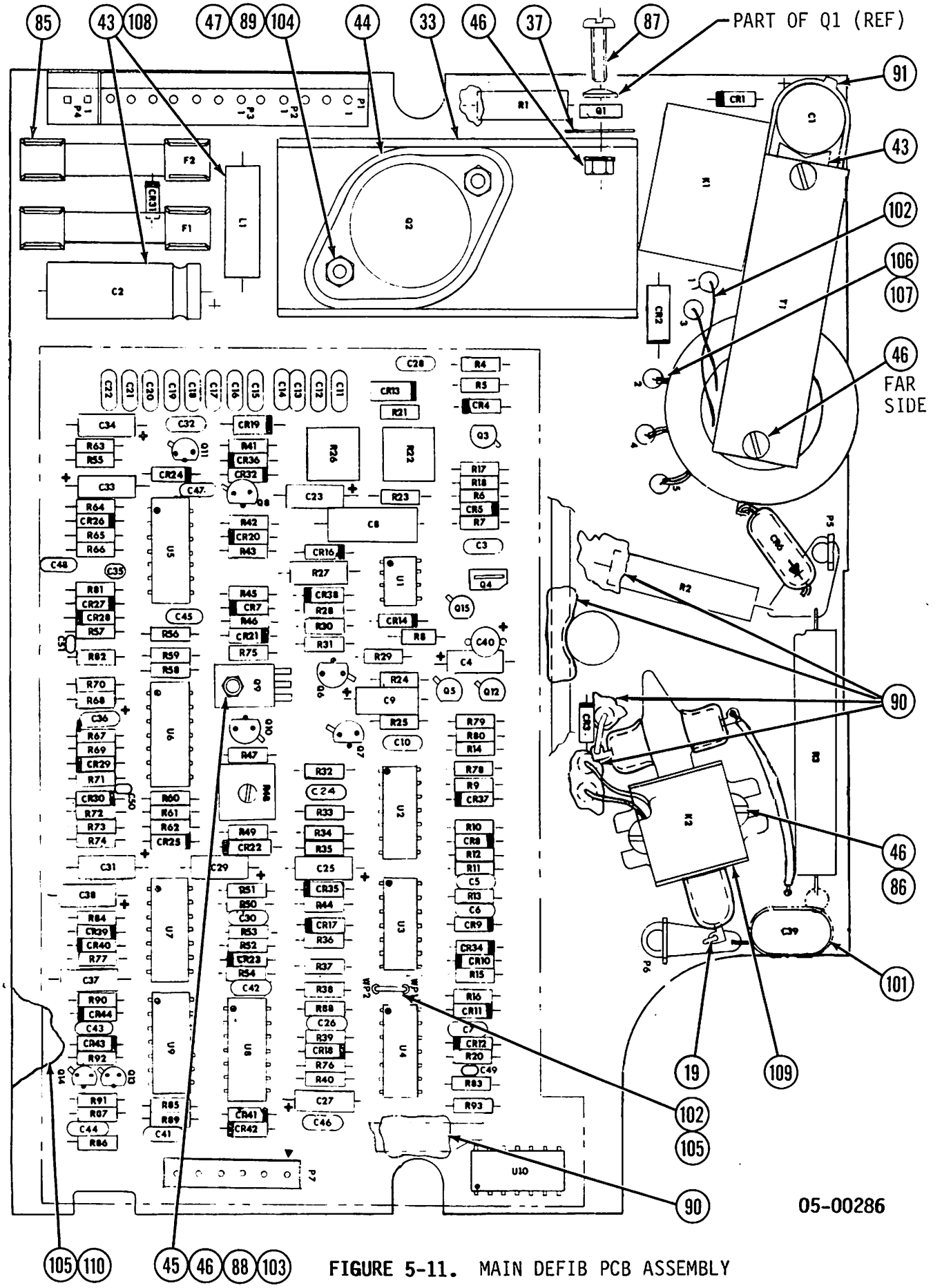


FIGURE 5-11. MAIN DEFIB PCB ASSEMBLY

PARTS LIST

FIG AND ITEM NO.	REF. DES.	PCC PART NO.	DESCRIPTION	UNITS PER ASSY	USED ON CODE
5-11					
1		05-00286-09	MAIN DEFIB PCB ASSY	REF	A
		05-00286-10	MAIN DEFIB PCB ASSY, HI ENERGY	REF	B
		05-00286-11	MAIN DEFIB PCB ASSY, HI ENERGY, TUV	REF	C
2	C1	02-12729-00	CAPACITOR, LYTIC RAD, 560µF/20V, 10%	1	
3	C2	200590-111	CAPACITOR, LYTIC AXL, 100µF/25V, 75%	1	
4	1.	802016-000	CAPACITOR, DISC RAD, .01µF/500V, 80%	21	A
		200507-008	CAPACITOR, DISC RAD, .01µF/500V, 80%	20	B,C
5	2.	200546-016	CAPACITOR, TANT AXL, 2.2µF/20V, 10%	11	
6	C7	200593-005	CAPACITOR, DISC RAD, 270pF/1K, 10%	1	
7	C8	200495-049	CAPACITOR, MF, 2200pF/500V, 5%	1	
8	C35	200901-215	CAPACITOR, MONO RAD, 1000pF/100V,10%	1	
9	C36	200932-000	CAPACITOR, TANT RAD, 10µF/35V, 10%	1	
10	C39	200240-016	CAPACITOR, DISC RAD, 50pF/6K, 20%	1	
11	C40	200280-053	CAPACITOR, TANT RAD, 10µF/35V, 10%	1	
12	C41	200507-019	CAPACITOR, DISC RAD, 1000pF/1K, 100%	1	
13	C42,43, 44	200264-018	CAPACITOR, MONO RAD, .1µF/50V, 20%	3	A
	C19,42, 43,44	200264-018	CAPACITOR, MONO RAD, .1µF/50V, 20%	4	B,C
14	C45,46	200901-022	CAPACITOR, MONO, RAD, 100pF/50V, 5%	2	
15	C47,48	200901-095	CAPACITOR, MONO RAD, .001µF/100V, 5%	2	
16	C49	200901-092	CAPACITOR, MONO RAD, 560pF/50V, 5%	1	
17	C50	200901-205	CAPACITOR, MONO RAD, 150pF/100V, 10%	1	
18	C51	200893-068	CAPACITOR, MONO RAD, 2700pF/50V, 10%	1	
19		200405-020	CABLE, UNSHLD, 1 COND #22 STRND	A/R	
20	P1-3	200096-010	CONNECTOR, MALE FRIC, 12 PIN	1	
21	P4	200096-000	CONNECTOR, PLUG LOCK, 2 PIN	1	
22	P5,6	02-20171-00	CONNECTOR, PLUG CRIMP	2	
23	P7	200462-004	CONNECTOR, PLUG WAFER, 2 PIN	1	
24	3.	200971-000	DIODE, FAST REC, 1N914B	36	
25	CR2	200233-152	DIODE, ZENER, 1N5373B, 5W, 5%	1	
26	CR6	200881-000	DIODE, FAST REC, 300NS	1	

PARTS LIST

FIG AND ITEM NO.	REF. DES.	PCC PART NO.	DESCRIPTION	UNITS PER ASSY	USED ON CODE
5-11					
27	CR13	200034-000	DIODE, ZENER, 1N746A, .1W, 10%	1	
28	CR19	200605-017	DIODE, ZENER, 1N4745A, 1W, 5%	1	
29	CR22	200927-000	DIODE, ZENER, 1N821	1	
30	CR37	02-14027-00	DIODE, LO LEAK, FDH 300	1	
31	F1	200281-018	FUSE, FAST, 1A/250V	1	
32	F2	200281-037	FUSE, FAST, 15A/32V	1	
33		01-41543-00	HEATSINK	1	
34	U1	02-14359-00	I.C., LIN TIMER, NE555	1	
35	U2,8	02-14436-00	I.C., QUAD GATE, NOR, 74C02 ATTENTION	2	
36	U3	02-14437-00	I.C., QUAD GATE, NAND, 74C00 ATTENTION	1	
37	U4,5	02-14439-00	I.C., DUAL F/F D, 4013 ATTENTION	2	
38	U6	200485-002	I.C., QUAD OP-AMP, LM324	1	
39	U7	200698-000	I.C., DUAL TIMER, 556	1	
40	U9	200011-000	I.C., DUAL F/F D, MM74C74N ATTENTION	1	
41	U10	02-14426-00	I.C., SCHMIDT HEX INVERT, 74C14 ATTENTION	1	
42	L1	200833-013	INDUCTOR, RF AXL, 800MA, 500µH, 25%	1	
43		90-09089	INSULATOR, CRADLE MOUNT	3	
44		90-09106	INSULATOR, SILIPAD	1	
45		90-09107	INSULATOR, SILIPAD	2	
46		90-03019	KEPNUT, 4-40, CP, CS	6	
47		90-03021	KEPNUT, 6-32, CP, CS	2	
48	K1	02-18569-02	RELAY, ON/OFF, SPDT, 3A, 9V	1	
49	K2	801629-000	RELAY, VAC, H/V SPDT, 10A	1	A,B
		802053-00	RELAY, VAC, H/V SPDT, 10A PRETEST	1	C
50	R22,26	200504-012	POT, 50K, 1/2W, 20%, 1 TURN	2	
51	R48	200504-010	POT, 20K, 1/2W, 20%, 1 TURN	1	
52	R1	200270-028	RESISTOR, WW, 1.5, 2W, 5%	1	
53	R2	801648-00	RESISTOR, SC, 52M, 1.5W, 1%	1	
54	R3	800185-00	RESISTOR, PWR, 50K, 15W, 15%	1	
55	4.	200470-072	RESISTOR, CF, 1K, 1/4W, 5%	7	
56	5.	200470-096	RESISTOR, CF, 10K, 1/4W, 5%	18	

PARTS LIST

FIG AND ITEM NO.	REF. DES.	PCC PART NO.	DESCRIPTION	UNITS PER ASSY	USED ON CODE
5-11					
57	6.	200470-123	RESISTOR, CF, 130K, 1/4W, 5%	8	A
		200470-123	RESISTOR, CF, 130K, 1/4W, 5%	6	B,C
58	7.	200470-067	RESISTOR, CF, 620, 1/4W, 5%	6	
59	R8,33	200470-050	RESISTOR, CF, 120, 1/4W, 5%	2	
60	R9	200470-024	RESISTOR, CF, 10, 1/4W, 5%	1	
61	8.	200470-113	RESISTOR, CF, 51K, 1/4W, 5%	10	
62	9.	200470-038	RESISTOR, CF, 39, 1/4W, 5%	5	
63	10.	200470-084	RESISTOR, CF, 3.3K, 1/4W, 5%	5	
64	R27	200471-041	RESISTOR, CF, 51, 1/2W, 5%	1	
65	R46	200054-413	RESISTOR, MF, 200K, 1/8W, 1%, RN55C	1	
66	R47	200054-388	RESISTOR, MF, 110K, 1/8W, 1%, RN55C	1	A
	R47	200054-360	RESISTOR, MF, 56.2K, 1/8W, 1%, RN55C	1	B,C
67	R49	200054-423	RESISTOR, MF, 255K, 1/8W, 1%, RN55C	1	
68	R50	200470-062	RESISTOR, CF, 390, 1/4W, 5%	1	
69	R51	200054-468	RESISTOR, MF, 750K, 1/8W, 1%, RN55C	1	
70	R52	200054-445	RESISTOR, MF, 432K, 1/8W, 1%, RN55C	1	
71	R55	200470-090	RESISTOR, CF, 5.6K, 1/4W, 5%	1	
72	R56,58, 80,83	200470-143	RESISTOR, CF, 910K, 1/4W, 5%	4	
73	R59	200470-113	RESISTOR, CF, 51K, 1/4W, 5%	1	B,C
74	R60	200054-395	RESISTOR, MF, 130K, 1/8W, 1%, RN55C	1	
75	R61	200054-450	RESISTOR, MF, 487K, 1/8W, 1%, RN55C	1	
76	R62,66	200054-288	RESISTOR, MF, 10K, 1/8W, 1%, RN55C	2	
77	R70	200054-373	RESISTOR, MF, 76.8K, 1/8W, 1%, RN55C	1	A
	R70	200054-367	RESISTOR, MF, 66.5K, 1/8W, 1%, RN55C	1	B,C
78	R78	200468-168	RESISTOR, CF, 10M, 1/4W, 5%	1	
79	R79	200470-156	RESISTOR, CF, 3.3M, 1/4W, 5%	1	
80	R82	200470-139	RESISTOR, CF, 620K, 1/4W, 5%	1	B,C
81	R86,93	200470-120	RESISTOR, CF, 100K, 1/4W, 5%	2	
82	R87	200470-064	RESISTOR, CF, 470, 1/4W, 5%	1	
83	R89	200470-105	RESISTOR, CF, 24K, 1/4W, 5%	1	
84	R92	200470-099	RESISTOR, CF, 13K, 1/4W, 5%	1	

PARTS LIST

FIG AND ITEM NO.	REF. DES.	PCC PART NO.	DESCRIPTION	UNITS PER ASSY	USED ON CODE
5-11					
85		02-35464-00	RETAINER, FUSEHOLDER	4	
86		200475-260	SCREW, 4-40 x 1/4, BH, S, CP, CS	2	
87		200475-262	SCREW, 4-40 x 3/8, BH, S, CP, CS	1	
88		200475-263	SCREW, 4-40 x 7/16, BH, S, CP, CS	1	
89		200475-295	SCREW, 6-32 x 7/16, BH, S, CP, CS	2	
90		90-09035	SEALANT, RTV102, WHT	A/R	
91		90-10011	TIEWRAP, NYLON	1	
92	T1	02-18281-01	TRANSFORMER, FLYBACK, CSA, 25mH	1	
93	Q1,9	02-14608-00	TRANSISTOR, NPN, MJE223, +60V	2	
94	Q2	801718-00	TRANSISTOR, NPN, STA7026, +60V	1	
95	Q3,10, 12	200986-002	TRANSISTOR, NPN, EN2484, +60V	3	
96	Q4	02-14568-00	TRANSISTOR, NPN, D40D5, +45V	1	
97	Q5-8	200888-001	TRANSISTOR, PNP, PN2907A, +60V	4	
98	Q11	200942-001	TRANSISTOR, NPN, PN2222A, +40V	1	
99	Q13,14	200847-004	TRANSISTOR, PNP, PN3962, -60V	2	
100	Q15	200857-000	TRANSISTOR, NPN, PN2369A, +15V	1	
101		200283-077	TUBING, HEAT SHRINK, CLR, 1/2	A/R	
102		200624-004	TUBING, TEFLON NAT'L	A/R	
103		90-04004	WASHER, FLAT FIBER #4	1	
104		02-35378-00	WASHER, NYLON SHOULDER, #6	2	
105		90-09138	WIRE, BUSS, 22 AWG	A/R	
106		200283-019	TUBING, HEAT SHRINK, BLK, 1/4	A/R	
107		200283-017	TUBING, HEAT SHRINK, BLK, 1/8	A/R	
108		90-09262	ADHESIVE, HOT STUFF, INSTANT	A/R	
109		90-10055	RETAINER, CABLE TIE, NY	1	
110		800524-00	SHIELD, PCB	1	
		1.	C3,5,6,10-22,24,26,28,30,32 (THIS C19 ON UNIT A ONLY)		
		2.	C4,9,23,25,27,29,31,33,34,37,38		

PARTS LIST

FIG AND ITEM NO.	REF. DES.	PCC PART NO.	DESCRIPTION	UNITS PER ASSY	USED ON CODE
5-11					
		3.	CR1,3-5,7-12,14,16-18,20,21,23-32, 34-36,38-44		
		4.	R4,14,23,31,65,77,91		
		5.	R5,11,12,17,18,20,37,39,43, 44,68,69,75,81,84,85,88,90		
		6.	R6,35,45,54,59,63,71,82		
			R6,35,45,54,63,71		
		7.	R7,29,30,32,73,74		
		8.	R10,15,16,34,36,53,57,64,72,76		
		9.	R13,38,41,42,67		
		10.	R21,24,25,28,40		

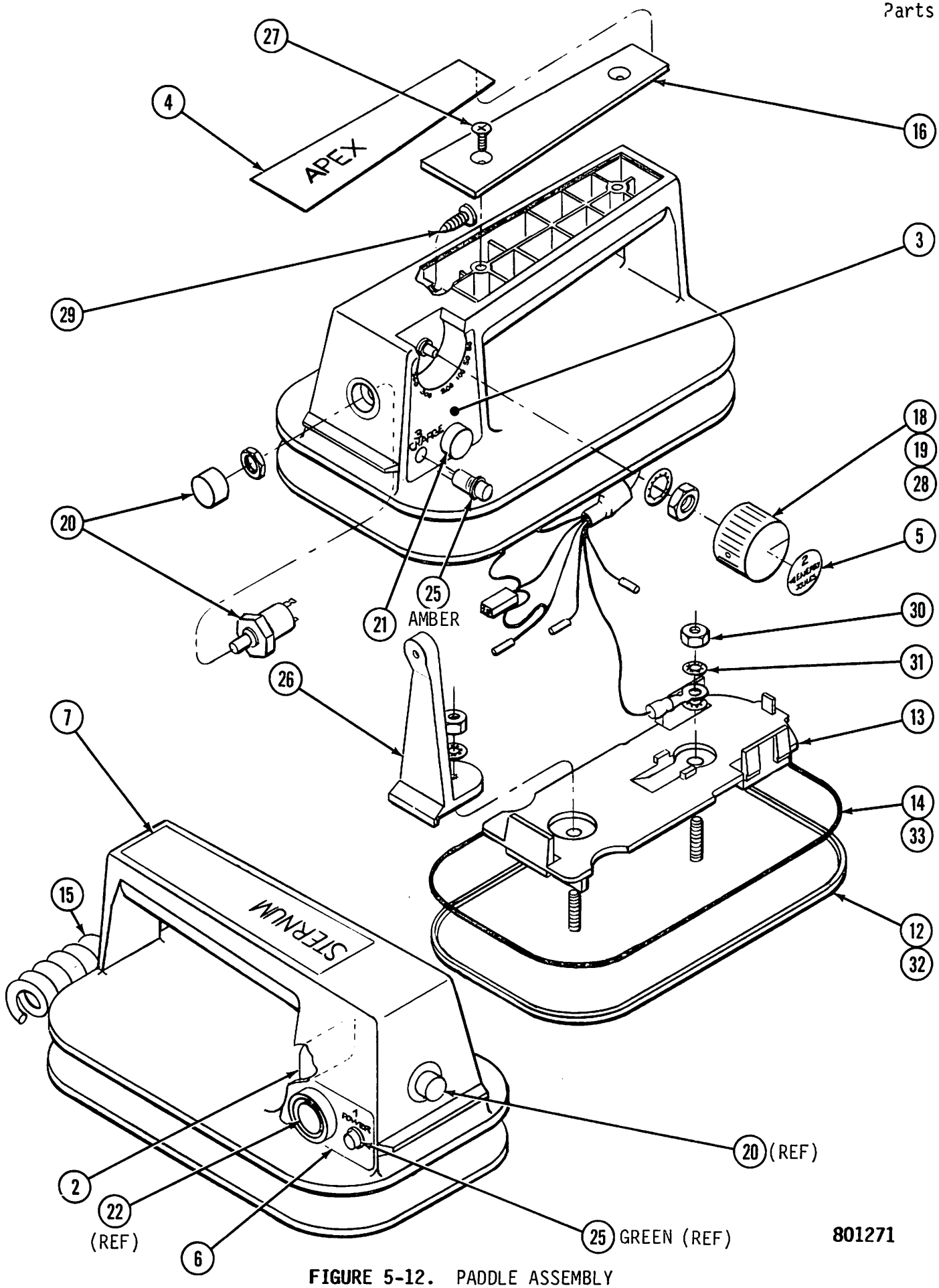


FIGURE 5-12. PADDLE ASSEMBLY

PARTS LIST

FIG AND ITEM NO.	REF. DES.	PCC PART NO.	DESCRIPTION	UNITS PER ASSY	USED ON CODE
5-12					
1		801271-25	APEX PADDLE ASSY, 360J, ENGLISH	REF	A
		801271-28	STERNUM PADDLE ASSY, ENGLISH	REF	B
		801271-29	APEX PADDLE ASSY, 360J, FRENCH	REF	C
		801271-31	STERNUM PADDLE ASSY, FRENCH	REF	D
		801271-32	APEX PADDLE ASSY, 360J, GERMAN	REF	E
		801271-34	STERNUM PADDLE ASSY, GERMAN	REF	F
		801271-35	APEX PADDLE ASSY, 360J, SPANISH	REF	G
		801271-37	STERNUM PADDLE ASSY, SPANISH	REF	H
2		800819-00	LABEL, SERIAL NUMBER	1	
3		800915-10	LABEL, CHARGE, ENG/FREN	1	A,C
		800815-11	LABEL, CHARGE, GERMAN	1	E
		800915-12	LABEL, CHARGE, SPANISH	1	G
4		800917-00	LABEL, APEX	1	A,C, E,G
5		801455-03	LABEL, KNOB, ENERGY SELECT, ENGLISH	1	A
		801455-04	LABEL, KNOB, ENERGY SELECT, FREN/GER	1	C,E
		801455-05	LABEL, KNOB, ENERGY SELECT, SPANISH	1	G
6		800916-05	LABEL, POWER, ENGLISH	1	B
		800916-06	LABEL, POWER, FRENCH	1	D
		800916-07	LABEL, POWER, GERMAN	1	F
		800916-08	LABEL, POWER, SPANISH	1	H
7		800917-01	LABEL, STERNUM	1	B,D,F
		800917-02	LABEL, STERNUM, SPANISH	1	H
8	*	01-41476-03	PADDLE TOP, APEX	1	A,C, E,G
9	*	01-41478-08	PADDLE BASE, APEX	1	A,C, E,G
10	*	01-41477-03	PADDLE TOP, STERNUM	1	B,D, F,H
11	*	01-41478-07	PADDLE BASE, STERNUM	1	B,D, F,H
12		01-41429-02	ELECTRODE PLATE, PADDLE	1	

PARTS LIST

FIG AND ITEM NO.	REF. DES.	PCC PART NO.	DESCRIPTION	UNITS PER ASSY	USED ON CODE
5-12					
13		800924-02	RETAINER, ELECTRODE PLATE	1	
14		200060-008	O-RING, RUBBER, 3.73 DIA	1	
15		801515-02	COIL CORD ASSY, APEX	1	A,C, E,G
		801515-03	COIL CORD ASSY, STERNUM	1	B,D, F,H
16		01-41538-02	ENCLOSURE, HANDLE COVER, TOP	1	
17	*	01-41479-01	INSERT, ROTARY SWITCH	1	A,C, E,G
18		01-41495-00	BUSHING, KNOB	1	A,C, E,G
19		01-41494-03	KNOB, ENERGY SELECT	1	A,C, E,G
20	SW1	801226-00	SWITCH, PB, SPST, 1/4 AMP, RED	1	
21	SW2	801226-091	SWITCH, PB, SPST, 1/4 AMP, BLK	1	
22	*	01-41480-03	INSERT, PUSHBUTTON	2	A,C, E,G
	*	01-41480-03	INSERT, PUSHBUTTON	1	B,D, F,H
23	*	800913-01	INSERT, PUSHBUTTON W/GUARD	1	B,D, F,H
24	1.	05-00287-08	PCB ASSY, RESISTOR, 360J		A,C, E,G
25	CR1	200030-002	LED AMBER	1	A,C, E,G
	CR1	200030-001	LED GREEN	1	B,D, F,H
26		801589-00	RETAINER BRACKET	1	
27		200320-035	SCREW, 4-40 X 5/16, FH, P, CP	2	
28		200543-013	SCREW, 6-32 X 1/7, ST, K, CP, KN, CUP	1	A,C, E,G
29		201352-000	SCREW, 6-19 X 3/8, PH, P, NP, STD	1	A,C, E,G

PARTS LIST

FIG AND ITEM NO.	REF. DES.	PCC PART NO.	DESCRIPTION	UNITS PER ASSY	USED ON CODE
5-12					
		200531-214	SCREW, 6-18 X 3/8, PH, P, CP, STD, DU	1	B,D, F,H
30		90-03042	NUT, HEX, 8-32, SS, PV	2	
31		90-04057	WASHER, LOCK, IT, SS, #8	3	
32		90-09035	SEALANT, RTV 102, WHT	A/R	
33		90-09034	LUBRICANT, SILICONE GREASE	A/R	
		*	ITEMS INDICATED WITH * ARE BONDED AND NON-REPLACEABLE.		
		1.	IF P/N 05-00287-08 PCB ASSY FAILS, IT IS NON-REPLACEABLE AND A NEW APEX PADDLE ASSY MUST BE ORDERED.		

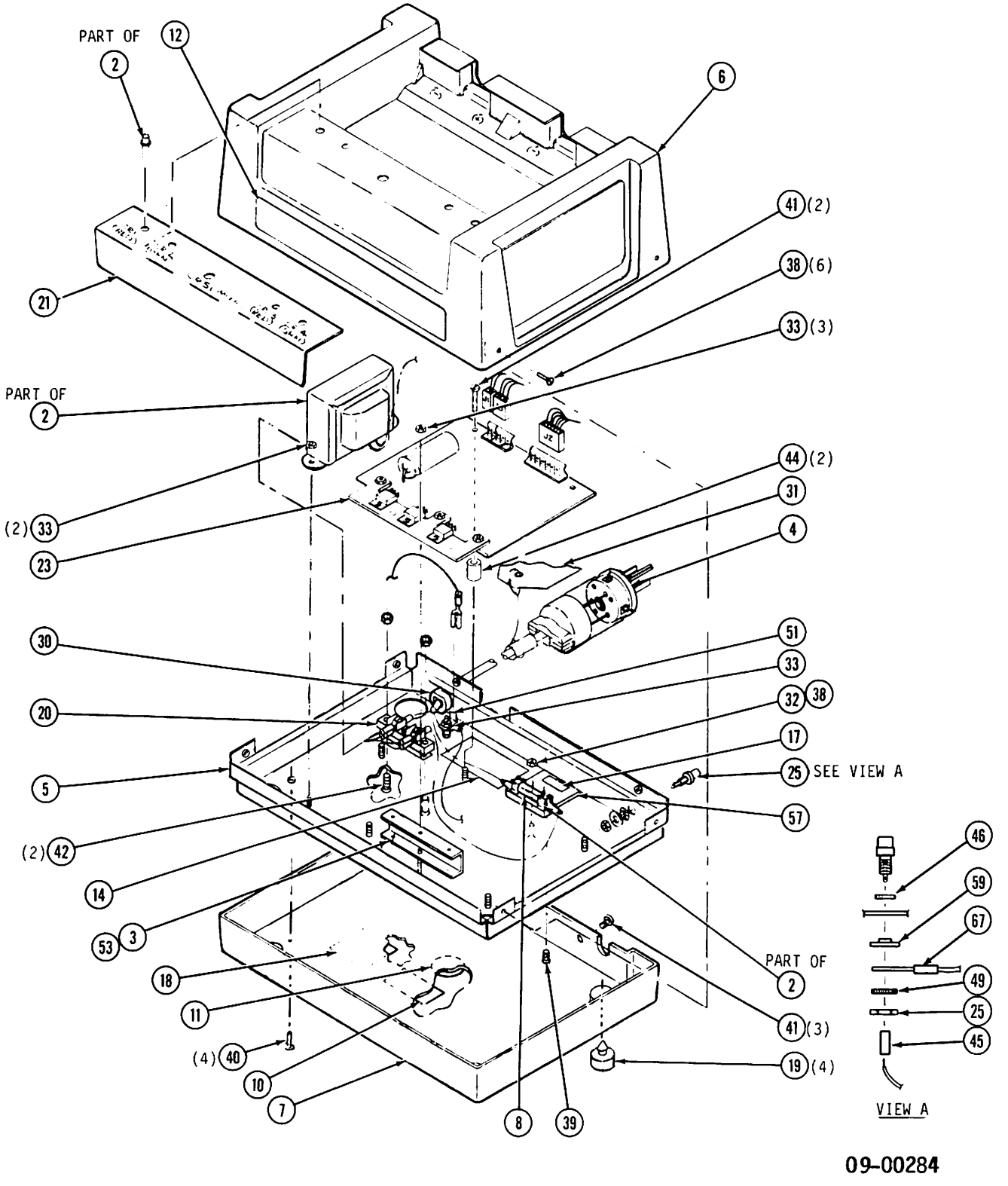


FIGURE 5-13. BATTERY CHARGER FINAL ASSEMBLY
(SHEET 1 OF 3)

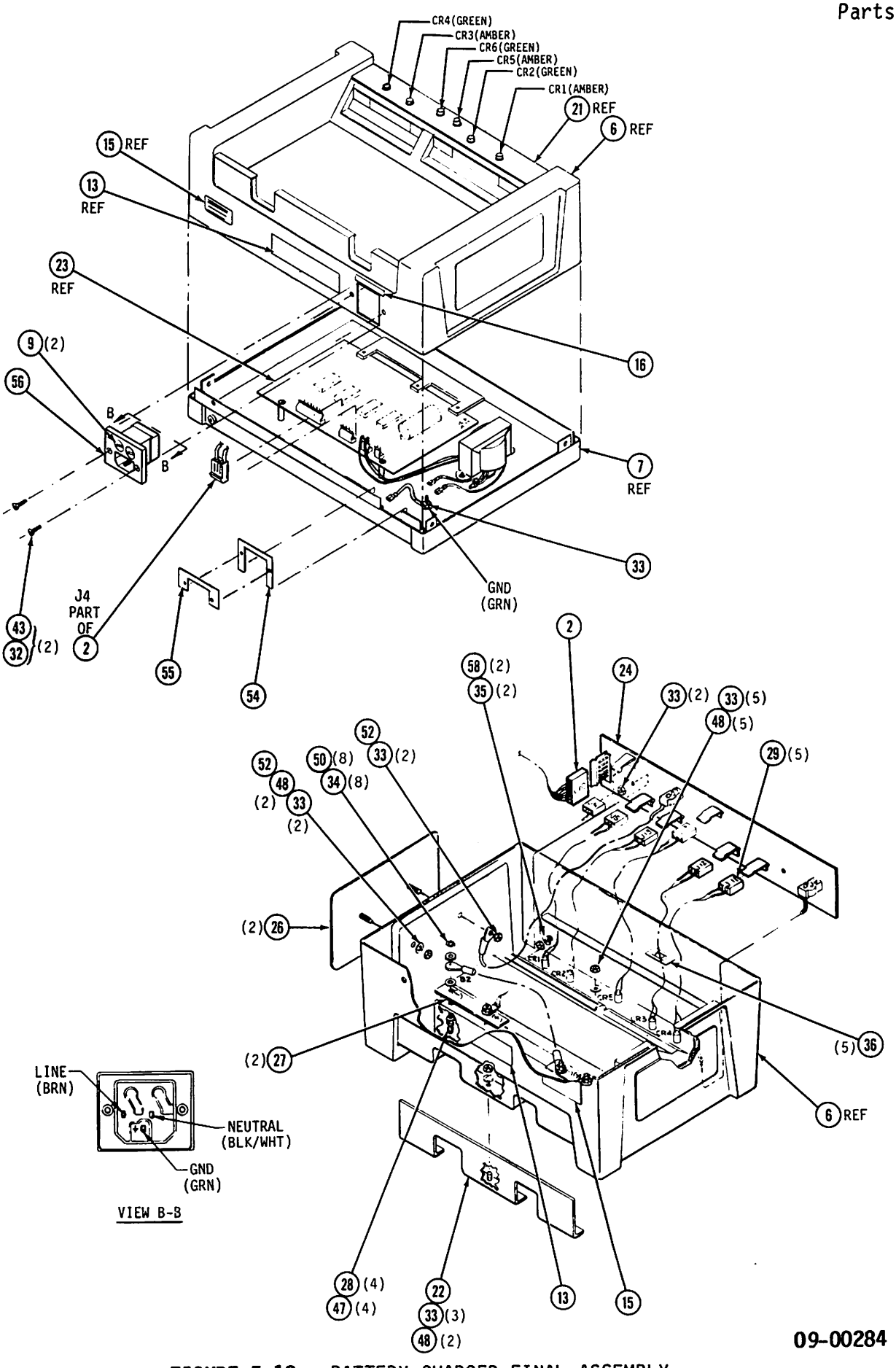


FIGURE 5-13. BATTERY CHARGER FINAL ASSEMBLY
(SHEET 2 OF 3)

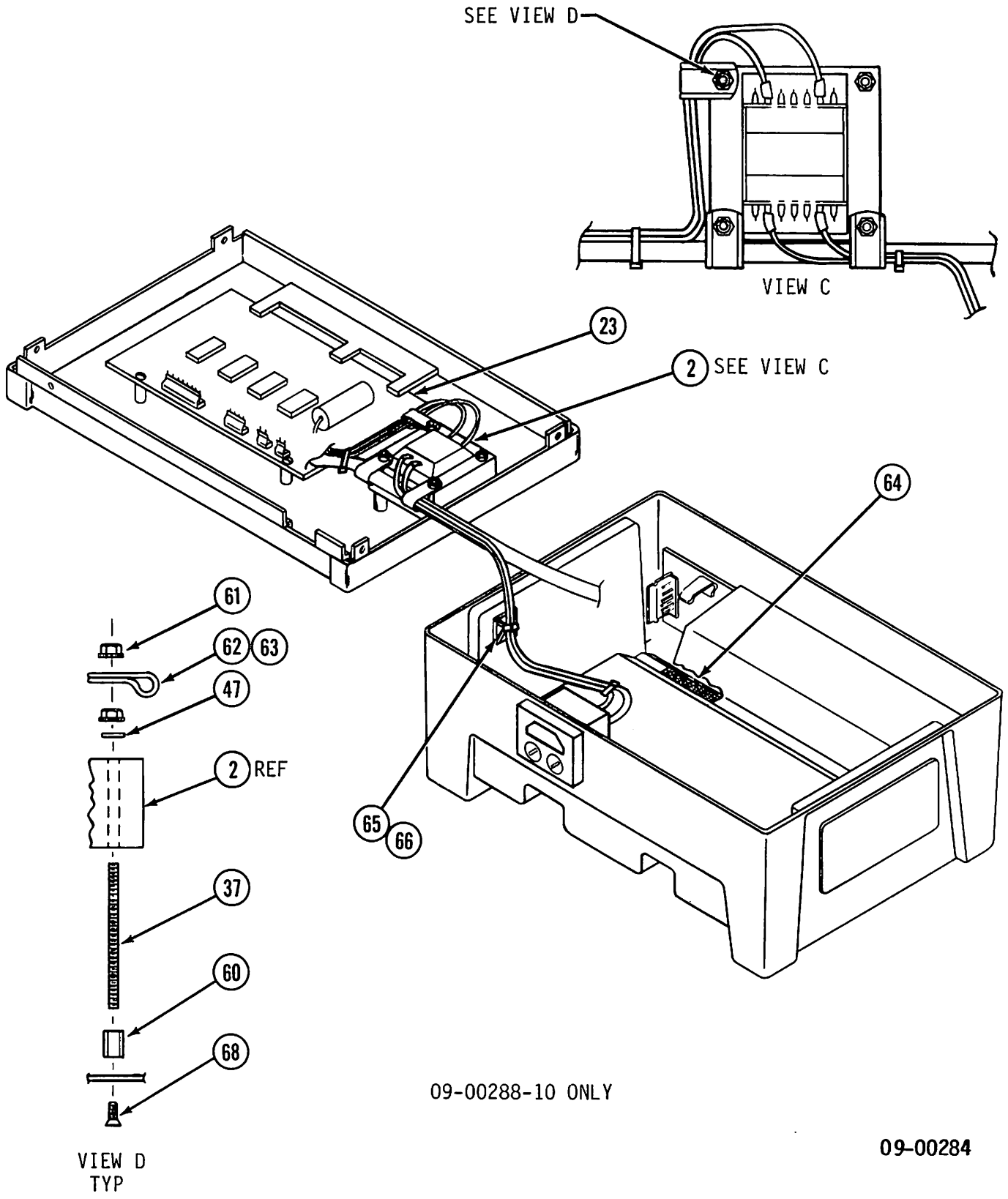


FIGURE 5-13. BATTERY CHARGER FINAL ASSEMBLY
(SHEET 3 OF 3)

PARTS LIST

FIG AND ITEM NO.	REF. DES.	PCC PART NO.	DESCRIPTION	UNITS PER ASSY	USED ON CODE
5-13					
1		09-00284-09	BATTERY CHARGER FINAL ASSY, 115V	REF	A
		09-00288-08	BATTERY CHARGER FINAL ASSY, 220V	REF	B
		801530-00	BATTERY CHARGER FINAL ASSY, 115V, FRENCH	REF	C
		801530-01	BATTERY CHARGER FINAL ASSY, 220V, FRENCH	REF	D
		801530-02	BATTERY CHARGER FINAL ASSY, 220V, GERMAN, TUV	REF	E
		801530-03	BATTERY CHARGER FINAL ASSY, 220V, SPANISH	REF	F
		801530-04	BATTERY CHARGER FINAL ASSY, 115V, SPANISH	REF	G
2		04-50084-10	BAT CHGR WIRE HARNESS ASSY, 60HZ		A,C,G
		04-50084-11	BAT CHGR WIRE HARNESS ASSY, 50HZ		B,D,F
		04-50084-12	BAT CHGR WIRE HARNESS ASSY, TUV		E
3		01-41552-02	BRACKET, HEATSINK	1	
4		02-20190-00	CONN, PLUG, GROUNDING, 125V, 3 PIN	1	A,C,G
5		01-41527-08	CHASSIS, CHARGER	1	
6		01-41522-09	ENCLOSURE, TOP	1	A,C,G
		01-41522-10	ENCLOSURE, TOP, EUROPEAN	1	B,D, E,F
7		01-41523-06	ENCLOSURE, BOTTOM	1	A,C,G
		01-41523-07	ENCLOSURE, BOTTOM, EUROPEAN	1	B,D, E,F
8	F1	200281-015	FUSE, FAST, 1/2 AMP, 250V	1	A,C,G
9	F1,2	200603-004	FUSE, FAST, 1/4 AMP, 250V	2	B,D, E,F
10		801517-02	LABEL, U.L. LISTING	1	A
11		200795-000	LABEL, CLA APPROVAL	1	A
12		800727-12	LABEL, CAUTION, INSTRUCTION	1	A
		800727-13	LABEL, CAUTION, INSTRUCTION	1	B
13		801495-04	LABEL, CAUTION, SHOCK	1	A,B

PARTS LIST

FIG AND ITEM NO.	REF. DES.	PCC PART NO.	DESCRIPTION	UNITS PER ASSY	USED ON CODE
5-13					
14		801362-03	LABEL, WARNING, FUSE	1	A,C,G
15		01-50330-03	LABEL, INPUT, 12 VDC	1	A,B
16		01-50335-04	LABEL, WARNING, BATT CHGR, .25 AMP	1	B
17		800417-00	LABEL, FUSE	1	A,C,G
18		801518-01	LABEL - SERIAL NUMBER, CSA	1	A
		801518-00	LABEL - SERIAL NUMBER, U.K.	1	B
19		201311-000	FOOT BLACK, MOUNTING	4	
20		801448-00	INSULATOR - BATT CHARGER	1	A,C,G
21		01-41530-11	PANEL, FRONT	1	A,C,G
		01-41530-12	PANEL, FRONT, EUROPEAN	1	B,D, E,F
22		01-41565-03	PANEL, BACK	1	
23		800413-00	BATTERY CHARGER PCB ASSY	1	A,C,G
		800413-03	BATTERY CHARGER PCB ASSY, EUROPEAN	1	B,D, E,F
24		05-00298-05	TEST LOAD PCB ASSY	1	A,B,D, D,F,G
		05-00298-06	TEST LOAD PCB ASSY	1	E
25	J14	02-35493-00	CONNECTOR, PHONE JACK RECPT	1	
26		01-41531-01	PLATE, PADDLE	2	
27		01-41535-02	PLATE, RETAINER	2	
28		201171-000	CONN, PLUG, BANANA	4	
29	J5,9, 11-13	200277-000	CONN - HOUSING, RCPT, 2 PIN	5	
30		200050-020	BUSHING, STRAIN RELIEF, NYLON	1	A,C,G
31		800850-01	LABEL, POWER CORD GND	1	A,C,G
32		90-03019	KEPNUT, 4-40 x 1/4, CP, CS	1	A,C,G
		90-03019	KEPNUT, 4-40 x 1/4, CP, CS	2	B,D, E,F
33		90-03021	KEPNUT, 6-32 x 1/4, CP, CS	21	A,B,C D,F,G
		90-03021	KEPNUT, 6-32 x 1/4, CP CS	16	E
34		90-03005	NUT, HEX, 4-40 x 1/4, CP, CS	8	

PARTS LIST

FIG AND ITEM NO.	REF. DES.	PCC PART NO.	DESCRIPTION	UNITS PER ASSY	USED ON CODE
5-13					
35		90-03014	NUT, HEX, 6-32 x 1/4, ZP, CS	2	
36		90-03041	FASTNR-STUD, RECEIVER, PUSH-ON, LOCK	5	
37		201189-007	FASTNR-STUD, CS, CP, 4-40 x 2	4	E
38		200478-761	SCREW, 4-40 x 5/16, FH, P, CP, CS	7	A,C,G
		200478-761	SCREW, 4-40 x 5/16, FH, P, CP, CS	6	B,D, E,F
39		90-01225	SCREW, 4-40 x 5/16, FH, P, CP, CS SELF/TAP	1	A,C,G
40		200478-794	SCREW, 6-32 x 3/8, FH, P, CP, CS	4	
41		200475-294	SCREW, 6-32 x 3/8, BH, S, CP, CS	5	
42		200478-796	SCREW, 6-32 x 1/2, FH, P, CP, CS	2	A,C,G
43		201105-540	SCREW, 4-40 x 1/2, FH, P, B/OX	2	B,D, E,F
44		90-02064	SPACER, 11/16 x 1/4, RND, BZ, ZP, #6	2	
45		90-07061	TUBING, PVC #8, NTL	A/R	
46		200144-160	WASHER - FLAT NYLON 1/4	1	
47		90-04060	WASHER, FIBER FLAT, #4	4	A,B,C D,F,G
		90-04060	WASHER, FIBER FLAT, #4	8	E
48		90-04064	WASHER, FLAT, SS, CF, #6	11	E
		90-04064	WASHER, FLAT, SS, CF, #6	9	A,B,C, D,F,G
49		90-04027	WASHER, LOCK, I.T., SS 1/4	1	
50		90-04049	WASHER, LOCK, E.T., SS #4	8	
51		90-06074	TERMINAL - QK DISCONN, #6 LUG	1	A,B,C, D,F,G
52		90-09035	SEALANT, RTV 102 WHITE	A/R	
53		90-09105	INSULATOR - COMPOUND, THERMAL	A/R	
54		800965-03	BRACKET, RECEPTACLE	1	B,D, E,F
55		800965-04	BRACKET, RECEPTACLE	1	E
56		200602-000	RECEPTACLE, DUAL FUSEHOLDER, SC/TYPE	1	B,C,G
		200602-001	RECEPTACLE, DUAL FUSEHOLDER, SC/TYPE	1	E

PARTS LIST

FIG AND ITEM NO.	REF. DES.	PCC PART NO.	DESCRIPTION	UNITS PER ASSY	USED ON CODE
5-13					
57		801447-00	RETAINER - FUSEHOLDER BLOCK	1	A,C,G
58		90-04010	WASHER, FLAT, #6, CS CP	2	
59		200431-099	WASHER, SHOULDER, NY 1/4	1	
60		90-02007	SPACER, HX, BZ, ZP, #4	4	E
61		90-03040	KEPNUT, SS, 4-40	7	E
62		90-10017	RETAINER, CABLE CLAMP	2	E
63		90-10016	RETAINER, CABLE CLAMP	1	E
64		201295-020	FASTENER, LOOP HOOK	A/R	E
65		90-10019	FASTENER, CABLE TIE MOUNT	1	E
66		90-10055	RETAINER, CABLE TIE, NYL	1	E
67		90-06028	TERMINAL, RING LUG 1/4	1	E
68		90-01199	SCREW, 4-40 x 1/4, FH, P, BD	4	E
69	*	801451-06	CHARGER LABEL ASSY KIT, SPANISH, 115V	1	G
		801451-07	CHARGER LABEL ASSY KIT, SPANISH, 220V	1	F
		801495-07	LABEL, CAUTION, SHOCK	1	G,F
		801518-00	LABEL, SERIAL NUMBER	1	G,F
		801459-04	LABEL, FRONT PANEL, CHARGER, 115V	1	G
		801459-02	LABEL, FRONT PANEL, CHARGER, 220V	1	F
	1.	800727-15	LABEL, CAUTION, INSTRUCTIONS, 115V	1	G
		800727-11	LABEL, CAUTION, INSTRUCTIONS, 220V	1	F
		01-50330-03	LABEL, INPUT, 12V	1	G,F
		01-50335-04	LABEL, BATTERY CHARGER WARNING, .25 AMP	1	F
70		801452-10	CHARGER LABEL ASSY KIT, FRENCH, 115V	1	C
		801452-11	CHARGER LABEL ASSY KIT, FRENCH, 220V	1	D
		801495-05	LABEL, CAUTION, SHOCK	1	C,D
		801518-02	LABEL, SERIAL NUMBER, CSA	1	C
		801518-03	LABEL, SERIAL NUMBER	1	D
		801459-03	LABEL, CHARGER FRONT PANEL, 115V	1	C
	2.	801459-00	LABEL, CHARGER FRONT PANEL, 220V	1	D
		800727-14	LABEL, CAUTION INSTRUCTION, 115V	1	C

PARTS LIST

FIG AND ITEM NO.	REF. DES.	PCC PART NO.	DESCRIPTION	UNITS PER ASSY	USED ON CODE
5-13 70 (CONT)					
		800727-09	LABEL, CAUTION INSTRUCTION, 220V	1	D
		01-50330-07	LABEL, INPUT, 12V	1	C
		01-50330-04	LABEL, INPUT, 12V	1	D
		01-50330-04	LABEL, WARNING, CHARGER, BATTERY	1	D
71		801453-05	CHARGER LABEL ASSY KIT, GERMAN, 220V	1	E
		801495-06	LABEL, CAUTION, SHOCK	1	E
		801518-04	LABEL, SERIAL NUMBER	1	E
		801459-01	LABEL, CHARGER FRONT PANEL, 220V	1	E
	3.	800727-10	LABEL, CAUTION INSTRUCTION, 220V	1	E
		01-50330-05	LABEL, INPUT, 12V	1	E
		01-50335-04	LABEL, WARNING, CHARGER, BATTERY	1	E
		801646-01	LABEL, DATA	1	E
		*	ITEMS 69-71 NOT SHOWN ON DRAWINGS.		
		1.	PART OF ITEM 69, 801451.		
		2.	PART OF ITEM 70, 801452.		
		3.	PART OF ITEM 71, 801453.		

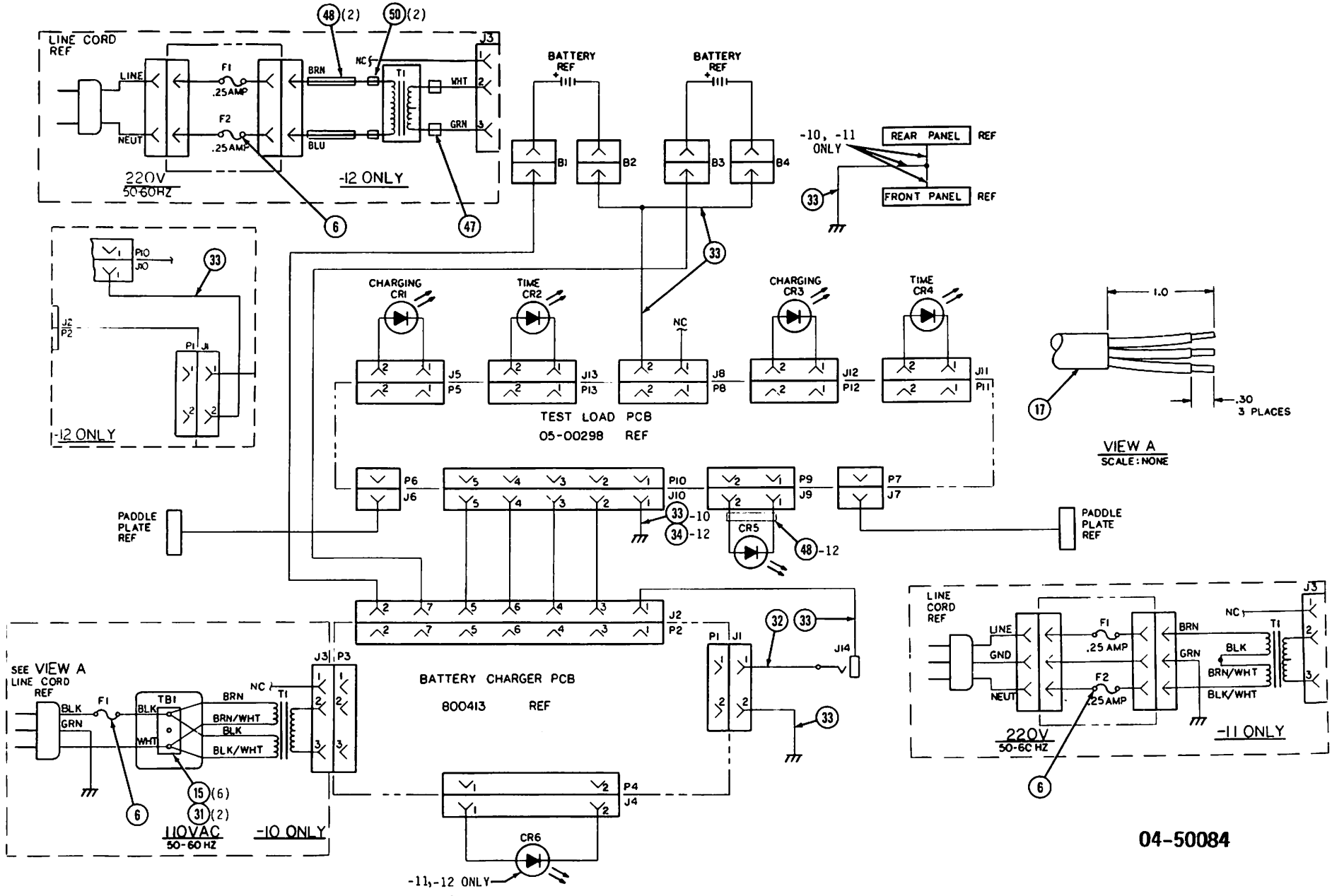


FIGURE 5-14. BATTERY CHARGER WIRE HARNESS ASSEMBLY.

PARTS LIST

FIG AND ITEM NO.	REF. DES.	PCC PART NO.	DESCRIPTION	UNITS PER ASSY	USED ON CODE
5-14					
1		04-50084-10	BATTERY CHARGER WIRE HARNESS ASSY, 110VAC	REF	A
		04-50084-11	BATTERY CHARGER WIRE HARNESS ASSY, 220VAC	REF	B
		04-50084-12	BATTERY CHARGER WIRE HARNESS ASSY, 220VAC, TUV	REF	C
2	CR5	02-14176-00	L.E.D., AMBER, BI-PIN, PNL MT, RND	1	A
	CR1,3,5	02-14176-00	L.E.D., AMBER, BI-PIN, PNL MT, RND	3	B,C
3	CR2,4	02-14178-00	L.E.D., GREEN, BI-PIN, PNL MT, RND	2	
4	CR1,3	02-14177-00	L.E.D., RED, BI-PIN, PNL MT, RND	2	A
5	CR6	02-14178-01	L.E.D., GREEN, BI-PIN, PNL MT, RND	1	B,C
6		02-22054-00	RETAINER, FUSEHOLDER	1	A
7	J3	200277-001	CONN, RCPT HOUSING, 3 PIN	1	
8	J10	200277-003	CONN, RCPT HOUSING, 5 PIN	1	
9	J1,8	200277-000	CONN, RCPT HOUSING, 2 PIN	2	A
	J1,4,8	200277-000	CONN, RCPT HOUSING, 2 PIN	3	B,C
10	J2	200277-005	CONN, RCPT HOUSING, 7 PIN	1	
11	T1	02-18214-03	TRANSFORMER, 120V/50-60HZ, CSA	1	A
	T1	02-18214-00	TRANSFORMER, 120V/50-60HZ	1	B
	T1	801710-00	TRANSFORMER, 220V/50-60HZ	1	C
12		02-20241-00	TERMINAL, CRIMP, 18-24 AWG	27	A
		02-20241-00	TERMINAL, CRIMP, 18-24 AWG	29	B,C
13		02-35186-00	IDENTIFICATION PAD	A/R	
14	TB1	200812-002	TERMINAL BARRIER STRIP, 3 PIN	1	A
15		200867-000	TERMINAL, TONGUE LUG, #4 INSUL	6	A
16		200514-000	TERMINAL, QK DISCON, RT ANGLE, 22-18	2	
17		200236-001	POWER CORD, 300V, #18, CSA	A/R	A
18		90-06069	TERMINAL, RING LUG, #6 RED, 22-16	6	A,B
		90-06069	TERMINAL, RING LUG, #6 RED, 22-16	4	C
19		200276-212	TERMINAL, RING LUG, 1/4 RED, 22-16	1	
20		200276-086	TERMINAL, RING LUG, #4 BLU, 16-14	1	
21		90-07059	TUBING, PVC NATL, #4	A/R	

PARTS LIST

FIG AND ITEM NO.	REF. DES.	PCC PART NO.	DESCRIPTION	UNITS PER ASSY	USED ON CODE
5-14					
22		90-07060	TUBING, PVC NATL, #6	A/R	
23		90-07061	TUBING, PVC NATL, #8	A/R	
24		90-08037	TAPE, ID MARKERS, LETTERS A & B	A/R	
25		90-10001	TERMINAL SPLICE, CLOSED END	1	A
		90-10001	TERMINAL SPLICE, CLOSED END	2	B
26		90-06038	TERMINAL, RING LUG, #6 BLU, 16-14	1	A,B
27		90-06034	TERMINAL, SLIP-ON LUG, 22-18	1	A,B
28		200916-000	TERMINAL, SLIP-ON LUG, 22-18	3	B,C
29		90-06072	TERMINAL, RING LUG, #4 RED, 22-18	3	
30		200405-020	CABLE, UNSHLD, STRND, 1 COND., #22, 20KV	A/R	
31		90-04049	WASHER, LOCK E.T., SS, #4	2	A
32		200357-056	WIRE, STRND, PVC, 300V, #18, CSA, RED	A/R	
33		200357-057	WIRE, STRND, PVC, 300V, #18, CSA, GRN	A/R	
34		200358-057	WIRE, STRND, PVC, 600V, #18, CSA, GRN	A/R	B
35		200358-082	WIRE, STRND, PVC, 600V, #20, CSA, BLK	A/R	
36		200357-109	WIRE, STRND, PVC, 300V, #22, CSA, BLK	A/R	
37		200357-110	WIRE, STRND, PVC, 300V, #22, CSA, RED	A/R	
38		200357-111	WIRE, STRND, PVC, 300V, #22, CSA, GRN	A/R	
39		200357-112	WIRE, STRND, PVC, 300V, #22, CSA, YEL	A/R	
40		200357-113	WIRE, STRND, PVC, 300V, #22, CSA, BLU	A/R	
41		200357-114	WIRE, STRND, PVC, 300V, #22, CSA, BRN	A/R	
42		200357-115	WIRE, STRND, PVC, 300V, #22, CSA, ORN	A/R	
43		200357-116	WIRE, STRND, PVC, 300V, #22, CSA, GRY	A/R	
44		200357-119	WIRE, STRND, PVC, 300V, #22, CSA, WHT/RED	A/R	
45		200357-054	WIRE, STRND, PVC, 300V, #18, CSA, WHT	A/R	C
46		200357-060	WIRE, STRND, PVC, 300V, #18, CSA, BRN	A/R	C
47		200283-017	TUBING, HEATSHRINK, BLK	A/R	C
48		90-07023	TUBING, PVC CLR, #10	A/R	C
49		200357-059	WIRE, STRND, PVC, 300V, #18, CSA, BLU	A/R	C
50		200283-018	TUBING, HEATSHRINK, BLK 3/16	A/R	C

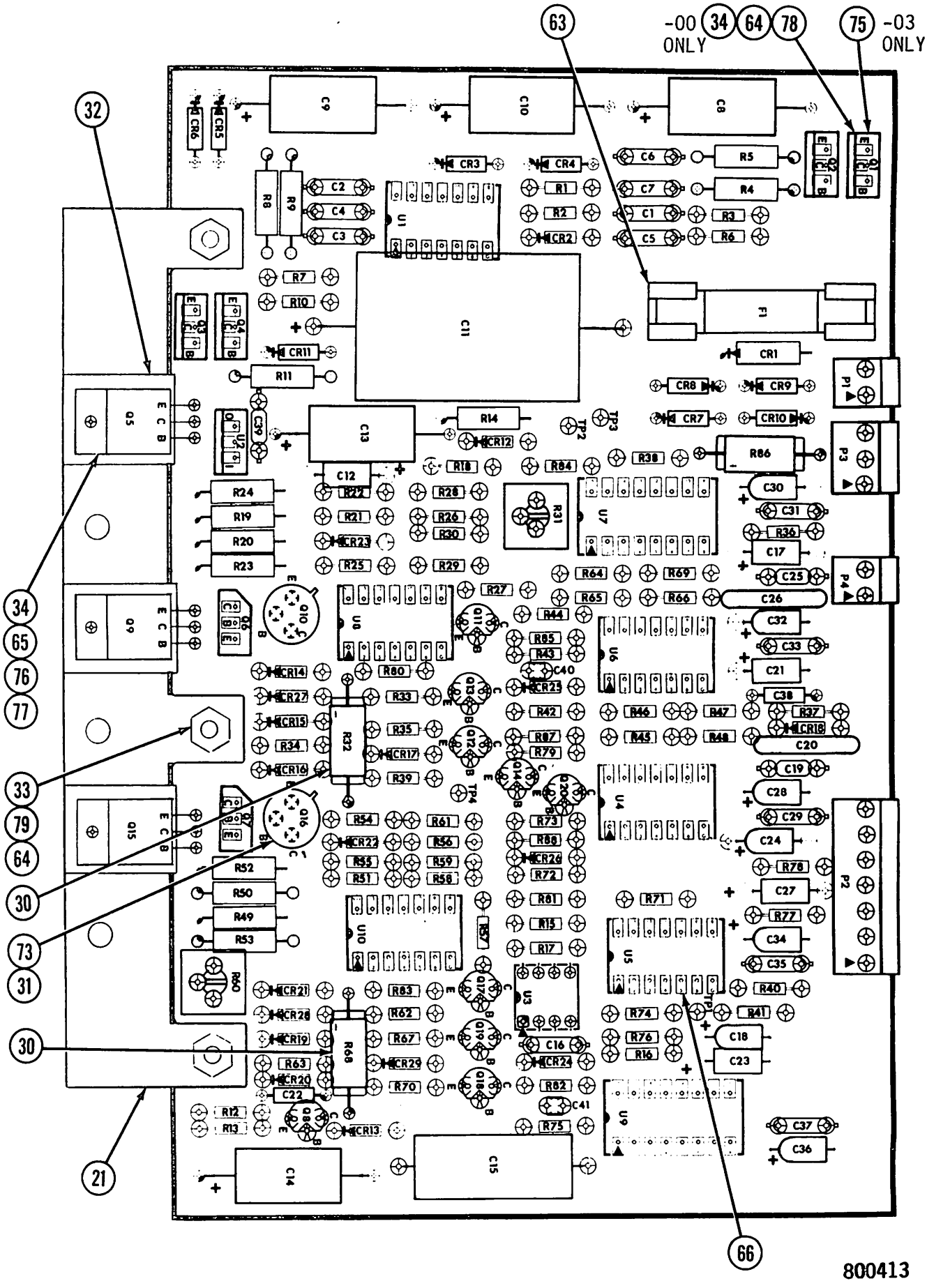


FIGURE 5-15. BATTERY CHARGER PCB ASSEMBLY

PARTS LIST

FIG AND ITEM NO.	REF. DES.	PCC PART NO.	DESCRIPTION	UNITS PER ASSY	USED ON CODE
5-15					
1		800413-00	BATTERY CHARGER PCB ASSY	REF	A
		800413-03	BATTERY CHARGER PCB ASSY, EUROPEAN	REF	B
2	1.	200507-008	CAPACITOR, DISC, .01µF/500V	13	
3	C8-10, 13,14	02-12654-00	CAPACITOR, LYTIC, 100µF/25V	5	
4	C11	200204-073	CAPACITOR, LYTIC, 1000µF/50V	1	
5	C12,17, 21,23, 27	200546-147	CAPACITOR, TANT, 1µF/50V	5	
6	C15	200744-027	CAPACITOR, MF, PC, WF, 5µF/50V	1	
7	2.	200546-016	CAPACITOR, TANT, 2.2µF/20V	7	
8	C19,25, 39	200264-018	CAPACITOR, MONO, .1µF/50V	3	
9	C20,26	200507-017	CAPACITOR, DISC, .05µF/500V	2	
10	C22,38	200049-039	CAPACITOR, MONO, .1µF/50V	2	
11	C40,41	200264-020	CAPACITOR, MONO, .22µF/50V2		
12	P1	200096-000	CONNECTOR, PLUG LOCK, 2 PIN	1	A
	P1,4	200096-000	CONNECTOR, PLUG LOCK, 2 PIN	2	B
13	P2	200096-005	CONNECTOR, PLUG LOCK, 7 PIN	1	
14	P3	200096-001	CONNECTOR, PLUG LOCK, 3 PIN	1	
15	CR1	200789-005	DIODE, HV PWR, 30S6	1	
16	3.	200971-000	DIODE, FAST REC, 1N914B	17	
17	CR3-6	200658-002	DIODE, FAST REC, MR812	4	
18	CR7-10, 22,23	200284-005	DIODE, RECTIFIER, 1N4005	6	
19	CR11	200605-022	DIODE, ZENER, 1N4750A	1	
20	F1	200281-022	FUSE, FAST, 2A/250V	1	
21		800447-00	HEATSINK, XSTR MOUNT	1	
22	U1	200698-000	I.C., LIN TIMER, NE556	1	
23	U2	200227-004	I.C., VOLT REG, POS, LM340T	1	
24	U3	02-14359-00	I.C., LIN TIMER, NE555	1	
25	U4	200348-001	I.C., CMOS, NAND GATE, 4011A	1	

PARTS LIST

FIG AND ITEM NO.	REF. DES.	PCC PART NO.	DESCRIPTION	UNITS PER ASSY	USED ON CODE
5-15					
26	U5	200252-000	I.C., CMOS, QUAD NOR, 4001B ATTENTION	1	
27	U6	02-14439-00	I.C., CMOS, F/F D, 4013B ATTENTION	1	
28	U7,9	200714-000	I.C., CMOS, COUNTER, 4040B ATTENTION	2	
29	U8,10	200485-002	I.C., QUAD OP-AMP, LM124J	2	
30		90-09089	INSULATOR, CAP/RES MOUNT	2	A
		90-09089	INSULATOR, CAP/RES MOUNT	3	B
31		90-09097	INSULATOR, XSTR MOUNT	2	
32		90-09107	INSULATOR, SILIPAD	3	
33		90-03019	KEPNUT, 4-40, CP, CS	3	
34		90-03001	NUT, HEX, 4-40, CP, CS	5	A
		90-03001	NUT, HEX, 4-40, CP, CS	3	B
35	R31,60	200504-008	POT, 5K, 1/2W, 20%, 1 TURN	2	
36	R1,2, 37,74	200470-103	RESISTOR, CF, 20K, 1/4W, 5%	4	
37	4.	200470-041	RESISTOR, CF, 51, 1/4W, 5%	8	
38	R4,5, 8,9	200471-055	RESISTOR, CF, 200, 1/2W, 5%	4	
39	R11	200471-068	RESISTOR, CF, 680, 1/2W, 5%	1	
40	5.	200470-072	RESISTOR, CF, 1K, 1/4W, 5%	15	
41	R14	200471-066	RESISTOR, CF, 560, 1/2W, 5%	1	
42	R15,17	200054-468	RESISTOR, MF, 750K, 1/8W, 1%, RN55C	2	
43	R18,42, 71	200470-096	RESISTOR, CF, 10K, 1/4W, 5%	3	
44	R19,20, 49,50	200471-083	RESISTOR, CF, 3K, 1/2W, 5%	4	
45	R21,25, 51,55	200054-305	RESISTOR, MF, 15K, 1/8W, 1%, RN55C	4	
46	R22,26, 54,56	200054-388	RESISTOR, MF, 110K, 1/8W, 1%, RN55C	4	
47	R23,52	200471-004	RESISTOR, CF, 1.5, 1/2W, 5%	2	
48	R24,53	200471-069	RESISTOR, CF, 750, 1/2W, 5%	2	
49	R27,57	200054-340	RESISTOR, MF, 34.8K, 1/8W, 1%, RN55C	2	

PARTS LIST

FIG AND ITEM NO.	REF. DES.	PCC PART NO.	DESCRIPTION	UNITS PER ASSY	USED ON CODE
5-15					
50	R28,61	200470-136	RESISTOR, CF, 470K, 1/4W, 5%	2	
51	R29,58	200054-401	RESISTOR, MF, 150K, 1/8W, 1%, RN55C	2	
52	R30,59	200054-282	RESISTOR, MF, 8.66K, 1/8W, 1%, RN55C	2	
53	R32,68	200578-100	RESISTOR, WW, 1.5K, 1W, 5%	2	A
	R32,68, 86	200578-100	RESISTOR, WW, 1.5K, 1W, 5%	3	B
54	R33,62	200470-141	RESISTOR, CF, 750K, 1/4W, 5%	2	
55	R35,39, 67,70	200470-107	RESISTOR, CF, 30K, 1/4W, 5%	4	
56	R36,41, 75,78	200470-144	RESISTOR, CF, 1M, 1/4W, 5%	4	
57	R43,72	200470-132	RESISTOR, CF, 330K, 1/4W, 5%	2	
58	R45,64	200470-112	RESISTOR, CF, 47K, 1/4W, 5%	2	
59	R47,66	200470-120	RESISTOR, CF, 100K, 1/4W, 5%	2	
60	R80,83	200470-083	RESISTOR, CF, 3K, 1/4W, 5%	2	
61	R81	200470-048	RESISTOR, CF, 100, 1/4W, 5%	1	
62	R87,88	200470-079	RESISTOR, CF, 2K, 1/4W, 5%	2	
63		02-35464-00	RETAINER, FUSEHOLDER	2	
64		200475-262	SCREW, 4-40 x 3/8, BH, S, CP, CS	5	A
		200475-262	SCREW, 4-40 x 3/8, BH, S, CP, CS	3	B
65		200478-762	SCREW, 4-40 x 3/8, FH, P, CP, CS, CSK	3	
66		200907-001	SOCKET, DIP, 14 PIN	1	
67	TP1-4	01-41605-00	TEST POINT, TERMNL	4	
68	Q1,3	02-14625-00	TRANSISTOR, PNP, TIP32A	2	
69	Q2,4, 5	200880-001	TRANSISTOR, NPN, TIP31A	3	
70	Q6,7	200781-000	TRANSISTOR, PNP, D41D5	2	
71	6.	200847-004	TRANSISTOR, NPN, PN3962	5	
72	Q9,15	02-14623-00	TRANSISTOR, PND, TIP30A	2	
73	Q10,16	02-14503-00	TRANSISTOR, NPN, 2N2102	2	
74	Q12,13, 18,19	02-14542-00	TRANSISTOR, NPN, PN2484	4	

PARTS LIST

FIG AND ITEM NO.	REF. DES.	PCC PART NO.	DESCRIPTION	UNITS PER ASSY	USED ON CODE
5-15					
75		201219-048	TUBING, HEAT SHRINK, CLR, 3/8	A/R	
76		02-35506-00	WASHER, SHOULDER, NYLON, #4	3	
77		90-04061	WASHER, LOCK, #4 SS, SPLIT	3	
78		201124-391	SPACER, RND, BZ, ZP, #4	2	A
79		800814-03	INSULATOR, THERMAL, COND	3	B
		1.	C1-7,16,29,31,33,35,37		
		2.	C18,24,28,30,32,34,36		
		3.	CR2,12-21,24-29		
		4.	R3,6,7,10,79,82,84,85		
		5.	R12,13,16,34,38,40,44,46, 48,63,65,69,73,76,77		
		6.	Q8,11,14,17,20		

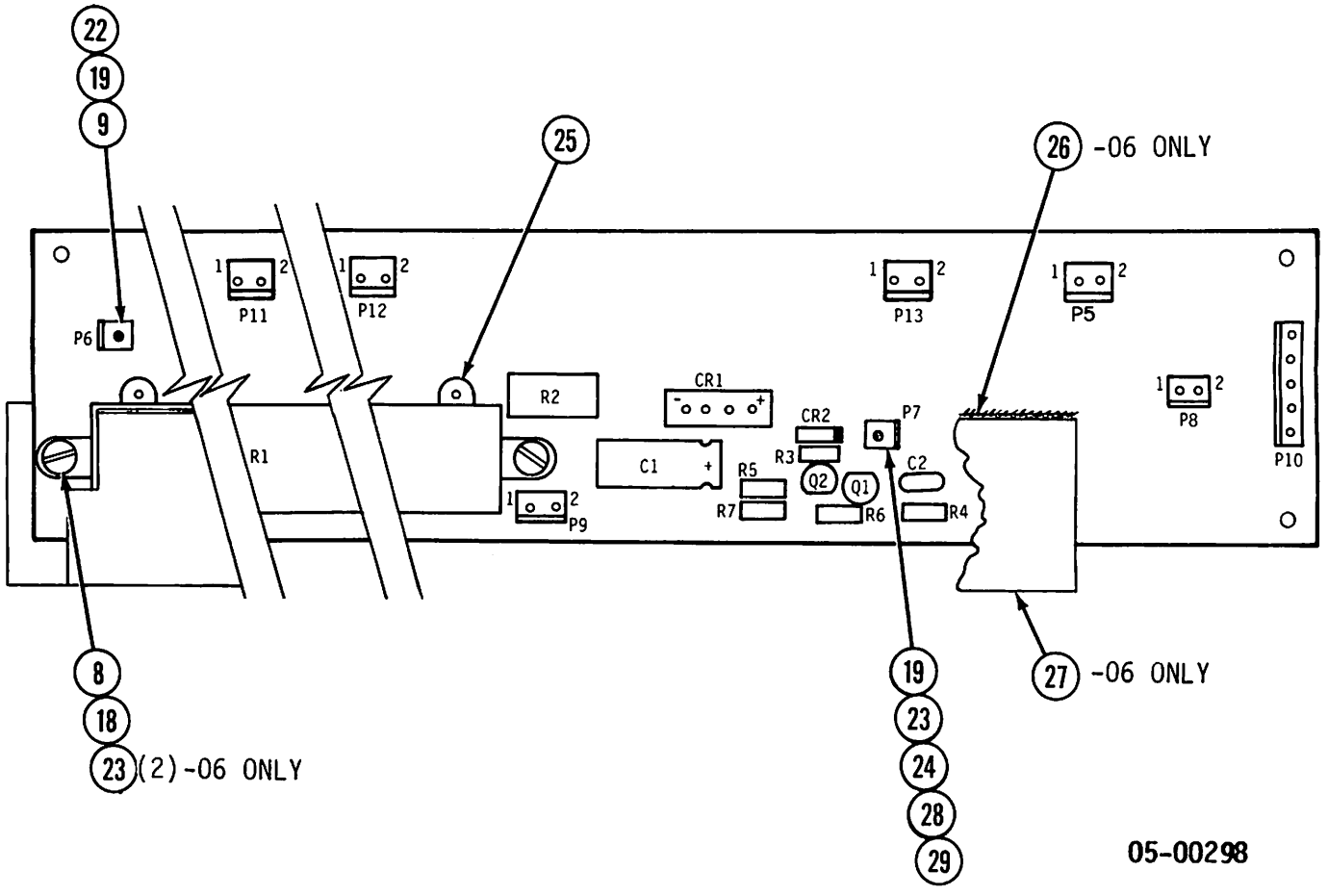


FIGURE 5-16. TEST LOAD PCB ASSEMBLY

PARTS LIST

FIG AND ITEM NO.	REF. DES.	PCC PART NO.	DESCRIPTION	UNITS PER ASSY	USED ON CODE
5-16					
1		05-00298-05	TEST LOAD, PCB ASSEMBLY	REF	A
		05-00298-06	TEST LOAD, PCB ASSEMBLY, INT'L	REF	B
2	C1	02-12654-00	CAPACITOR, LYTIC AXL, 100µF/25V, +75%	1	
3	C2	200507-008	CAPACITOR, DISC RAD, .01µF/500V, 80%	1	
4	P5,8,9, 11,12, 13	200096-000	CONNECTOR, PLUG, LOCK, 2 PIN	6	
5	P10	200096-003	CONNECTOR, PLUG, LOCK, 5 PIN	1	
6	CR1	200550-003	DIODE, BRIDGE RECT, KBP06	1	
7	CR2	200271-012	DIODE, ZENER, 1N3518, .4W, 5%	1	
8		90-03021	KEPNUT, 6-32 x 1/4, CP, CS	2	
9		90-03019	KEPNUT, 4-40 x 1/4, CP, CS	1	
10	P6,7	90-06074	LUG, SPADE TERMINAL, QK DISCON #6	2	
11	R1	02-09632-00	RESISTOR, WW, 50, 50W, 5%	1	
12	R2	200270-014	RESISTOR, WW, .39, 2W, 5%	1	
13	R3	200470-062	RESISTOR, CF, 390, 1/4W, 5%	1	
14	R4	200470-028	RESISTOR, CF, 15, 1.4W, 5%	1	
15	R5	200470-064	RESISTOR, CF, 470, 1/4W, 5%	1	
16	R6	200470-072	RESISTOR, CF, 1K, 1/4W, 5%	1	
17	R7	200470-052	RESISTOR, CF, 150, 1/4W, 5%	1	
18		200475-293	SCREW, 6-32 x 5/16, BH, S, CP	2	
19		200476-261	SCREW, 4-40 x 5/16, PH, S, CP	2	
20	Q1	200888-001	TRANSISTOR, 2N2907A, NPN, 60V	1	
21	Q2	200986-002	TRANSISTOR, EN2484, NPN, 60V	1	
22		90-04060	WASHER, #4 FLAT, CS, CP	1	
23		90-04064	WASHER, #6 FLAT, SS	1	A
		90-04064	WASHER, #6 FLAT, SS	3	B
24		02-35403-00	WASHER, SHOULDER, NYLON #4	1	
25		90-09136	WIRE, BUSS 18 AWG	A/R	
26		201295-085	FASTENER, LOOP CLOSURE	A/R	B
27		801695-00	NOMEX SHIELD	1	B
28		90-04061	WASHER, LOCK, SS #4	1	
29		201199-100	NUT, HEX, 4-40, CP	1	

AVAILABLE ACCESSORIES

9-10418-02	CABLE - PATIENT, 6-PIN, 3-LEAD, LOW NOISE, COLOR CODE AHA
800947-01	CABLE - PATIENT, 6-PIN, 3-LEAD, LOW NOISE, EUR, COLOR CODE, IEC
9-10419-003	PAPER, ECG, RECORDING, 3 ROLLS
9-10236-000	MEDICAL DERMA-JEL, TUBE
800139-003	ELECTRO - ECG, ADULT, LIFE PATCH (3)
9-10185-00	PAPER - RULER (ASSISTS IN PAPER CHART READING)
9-10429-01	ASSEMBLY KIT, STYLUS REPLACEMENT, TYPE A
9-10429-00	ASSEMBLY KIT, STYLUS REPLACEMENT
9-10447-01	ASSEMBLY KIT, CHARGER WALL MOUNTING
9-10426	OPERATING MANUAL, LP/5
9-10427	SERVICE MANUAL, LP/5
800966	POWER CORD ASSEMBLY (VARIOUS TERMINATIONS AVAILABLE)
801595	ECG VOICE RECORDER
801807	BATTERY SUPPORT SYSTEM

SECTION 6
SCHEMATICS

6.1 GENERAL

This section provides the engineering schematic drawings for LIFEPAK 5 electronic cardiac care instrument. Table 6-1 lists the schematic drawings for ECG Monitor/Recorder unit, DC Defibrillator unit, and the accessory equipment.

TABLE 6-1

SCHEMATIC DRAWINGS

DRAWING NO.*	NOMENCLATURE	FIGURE NO.
ECG MONITOR/RECORDER		
05-00284	PREAMP PCB SCHEMATIC	6-1
05-00291	NO-FADE PCB SCHEMATIC	6-2
05-00289	POWER SUPPLY AND RECORDER PCB SCHEMATIC	6-3
05-00308	SYNCHRONIZER PCB SCHEMATIC	6-4
05-00307	SURGE PROTECTOR PCB SCHEMATIC	6-5
DC DEFIBRILLATOR		
801271	PADDLE WIRING DIAGRAM	6-6
05-00286	MAIN DEFIB PCB SCHEMATIC	6-7
ACCESSORY EQUIPMENT - BATTERY/PAK CHARGER		
800413	BATTERY CHARGER PCB SCHEMATIC	6-8
05-00298	TEST LOAD PCB SCHEMATIC	6-9

*Check change information section at the rear of this manual.

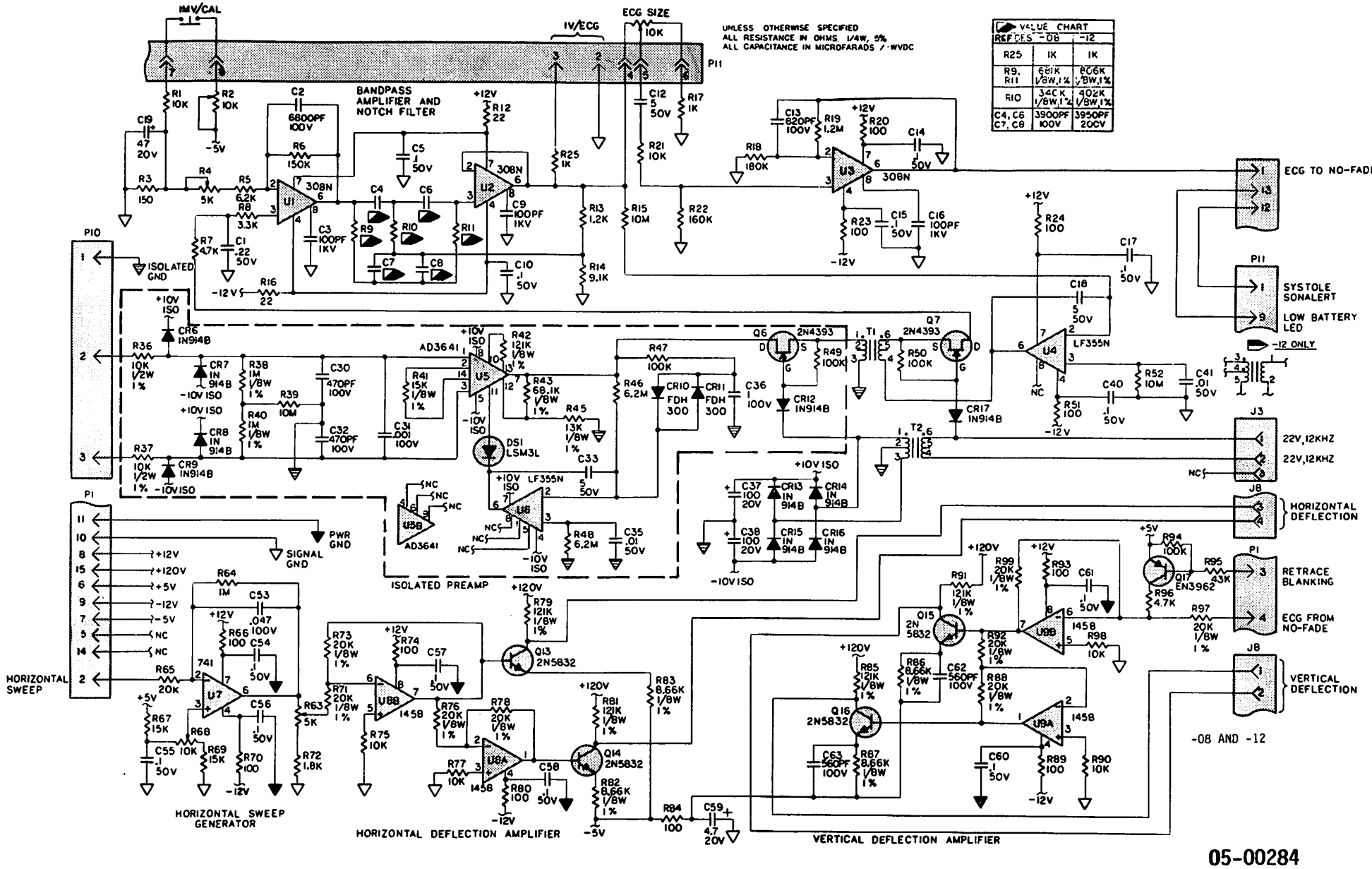


FIGURE 6-1. PREAMP PCB SCHEMATIC
(SHEET 1 OF 2)

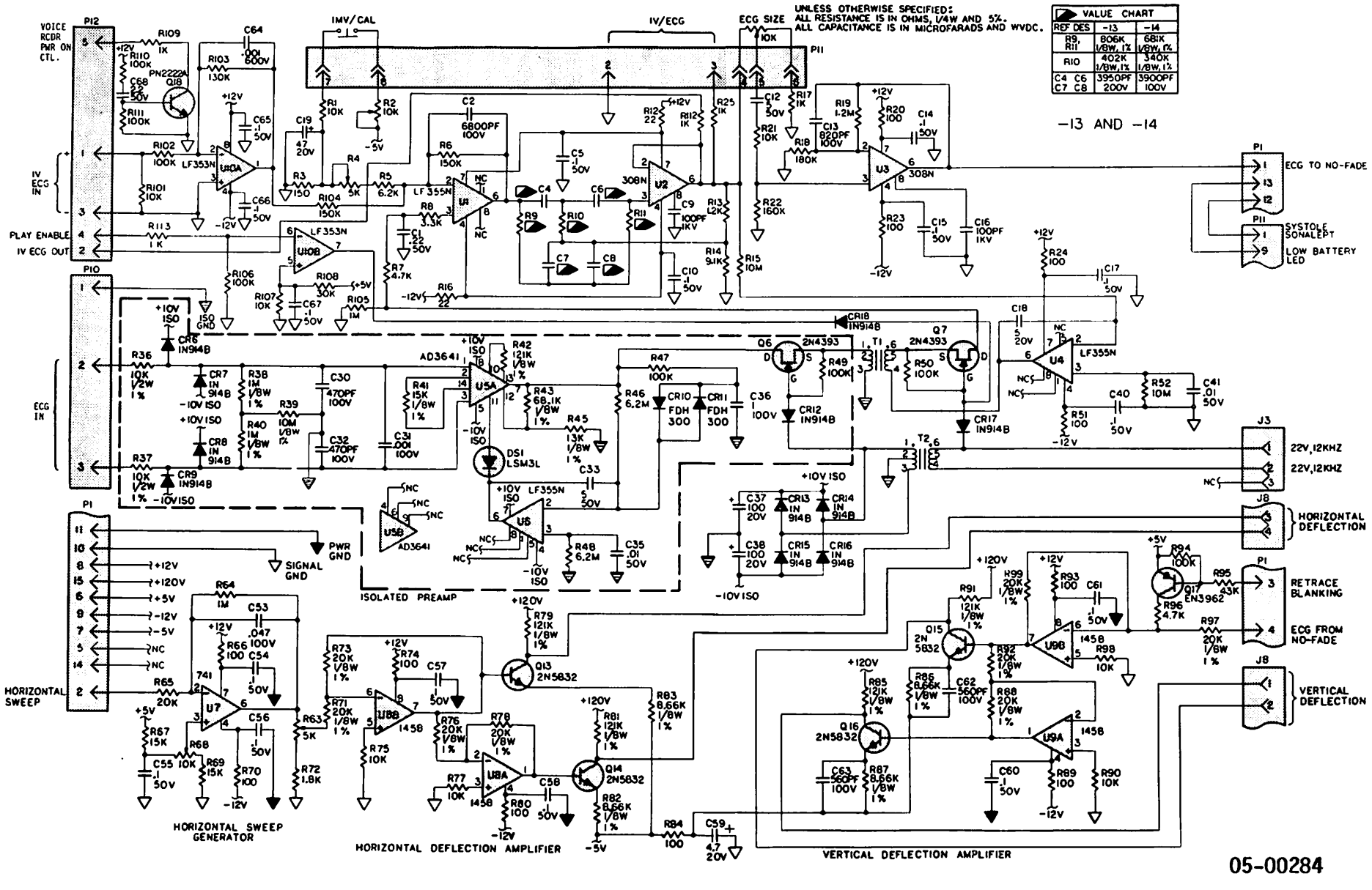


FIGURE 6-1. PREAMP PCB SCHEMATIC
(SHEET 2 OF 2)

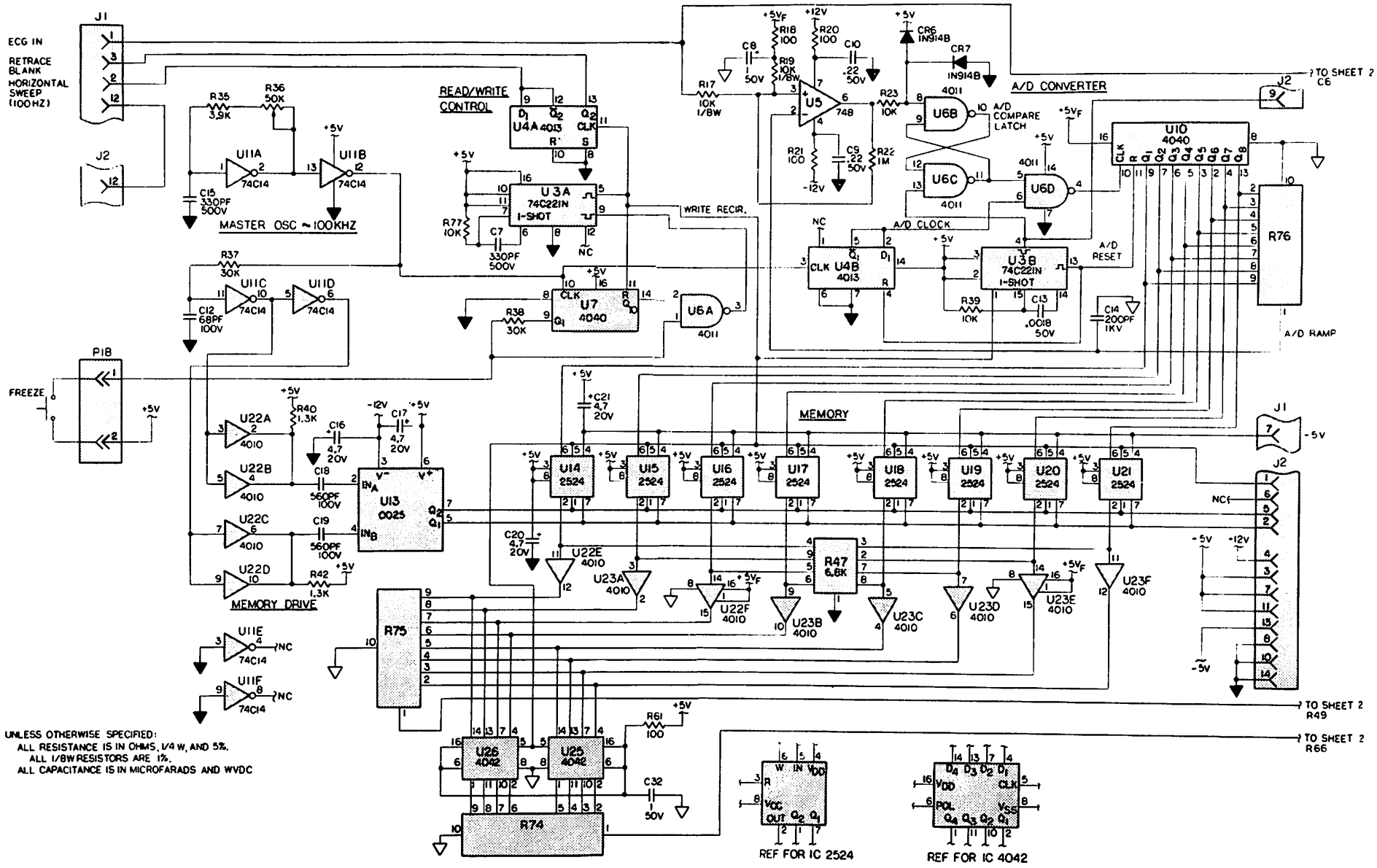


FIGURE 6-2. NO-FADE PCB SCHEMATIC
(SHEET 1 OF 2)

05-00291

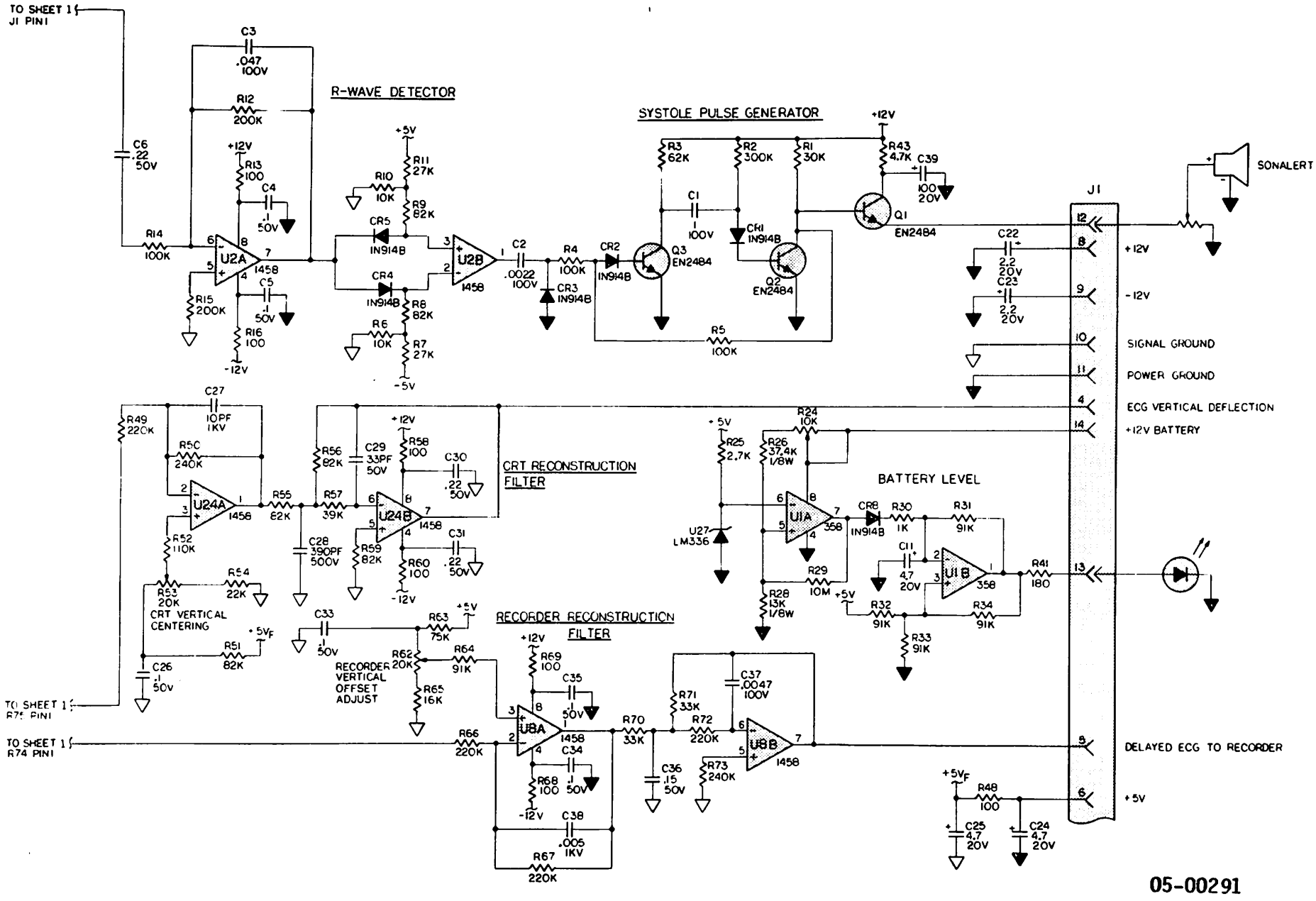


FIGURE 6-2. NO-FADE PCB SCHEMATIC
(SHEET 2 OF 2)

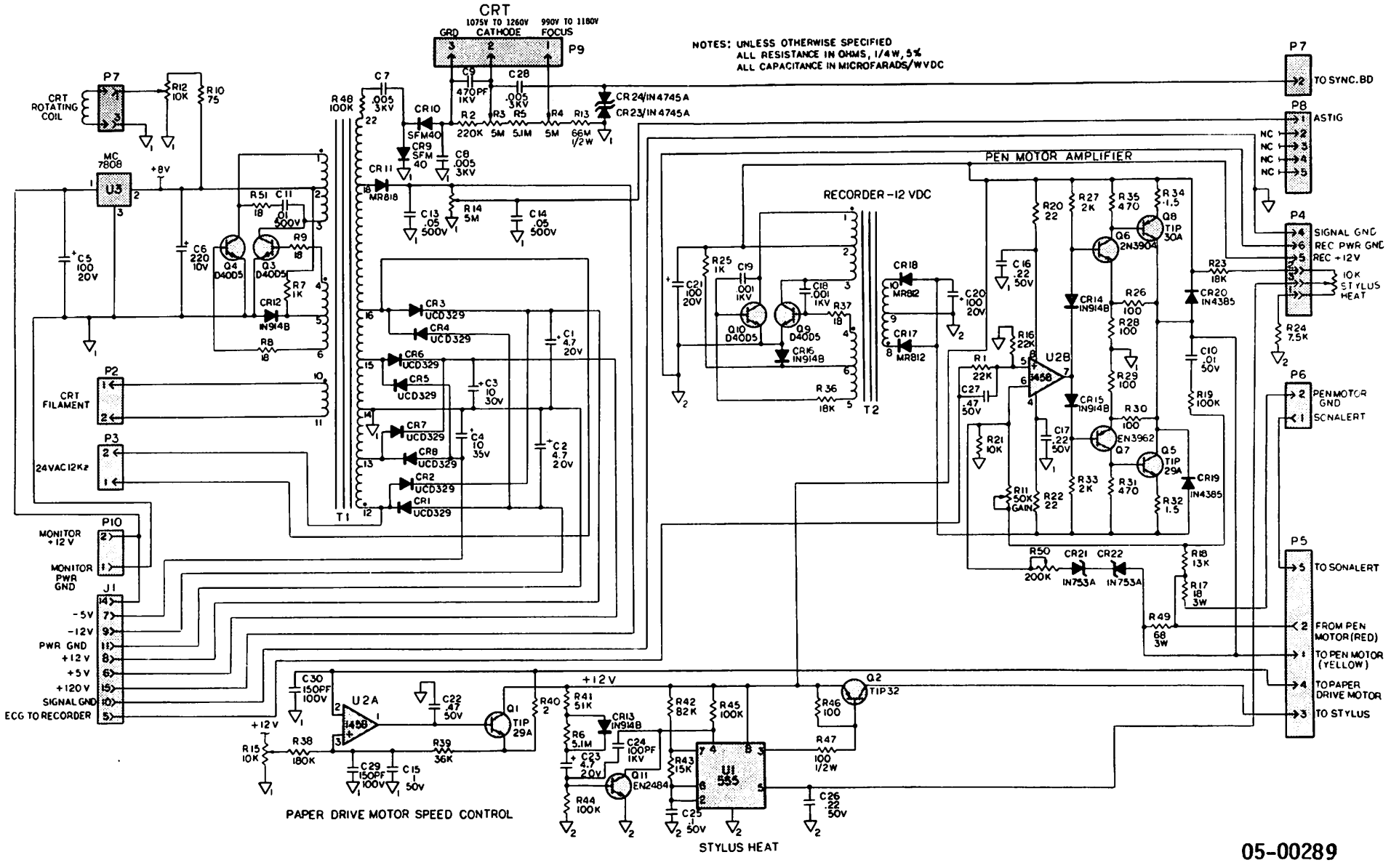


FIGURE 6-3. POWER SUPPLY AND RECORDER PCB SCHEMATIC

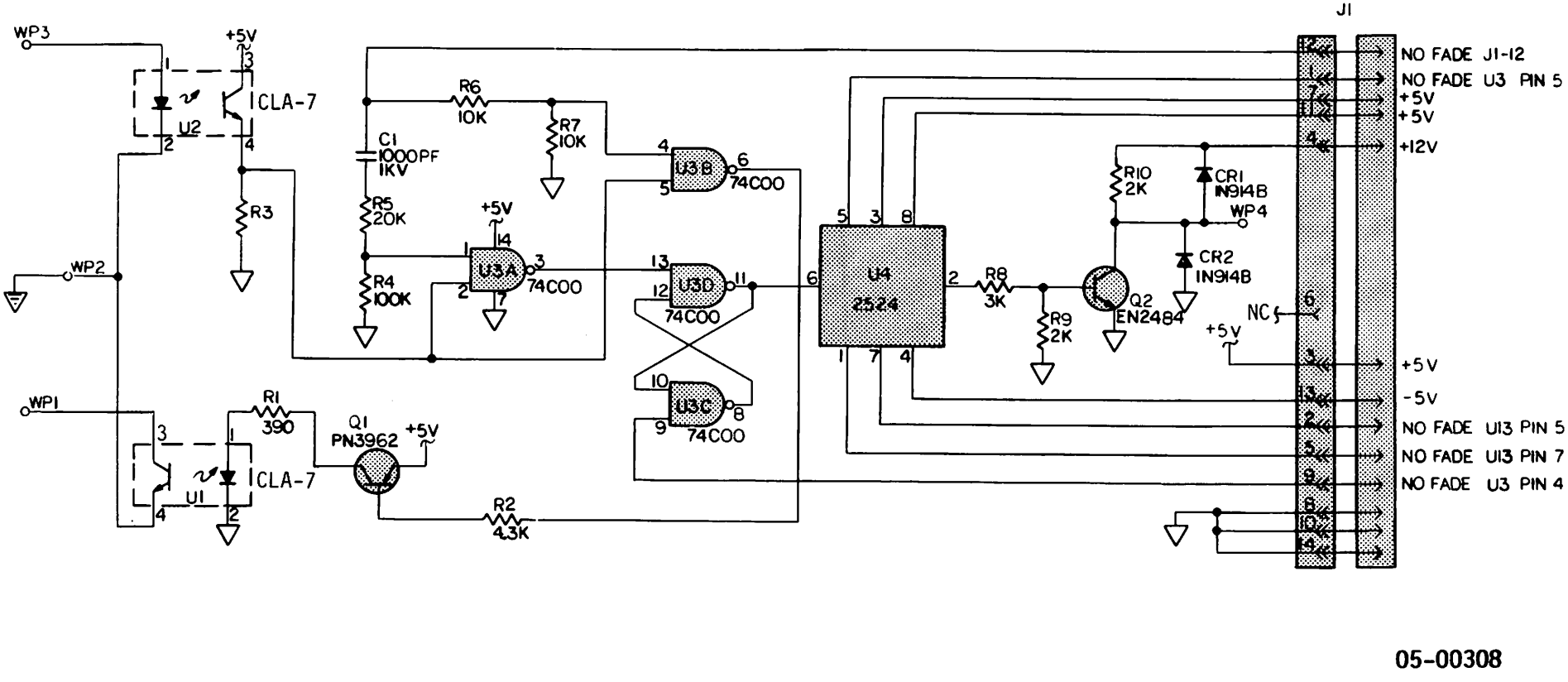


FIGURE 6-4. SYNCHRONIZER PCB SCHEMATIC

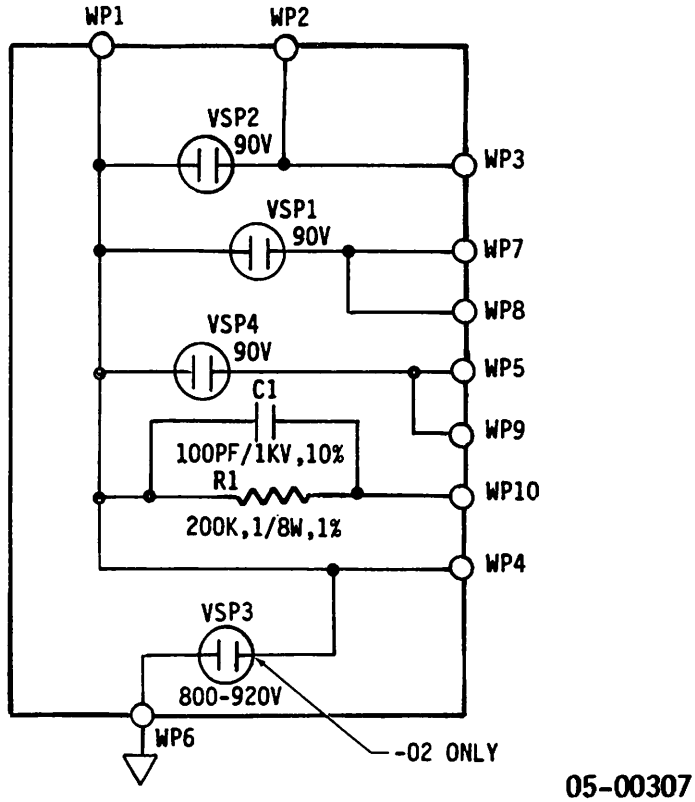


FIGURE 6-5. SURGE PROTECTOR PCB SCHEMATIC

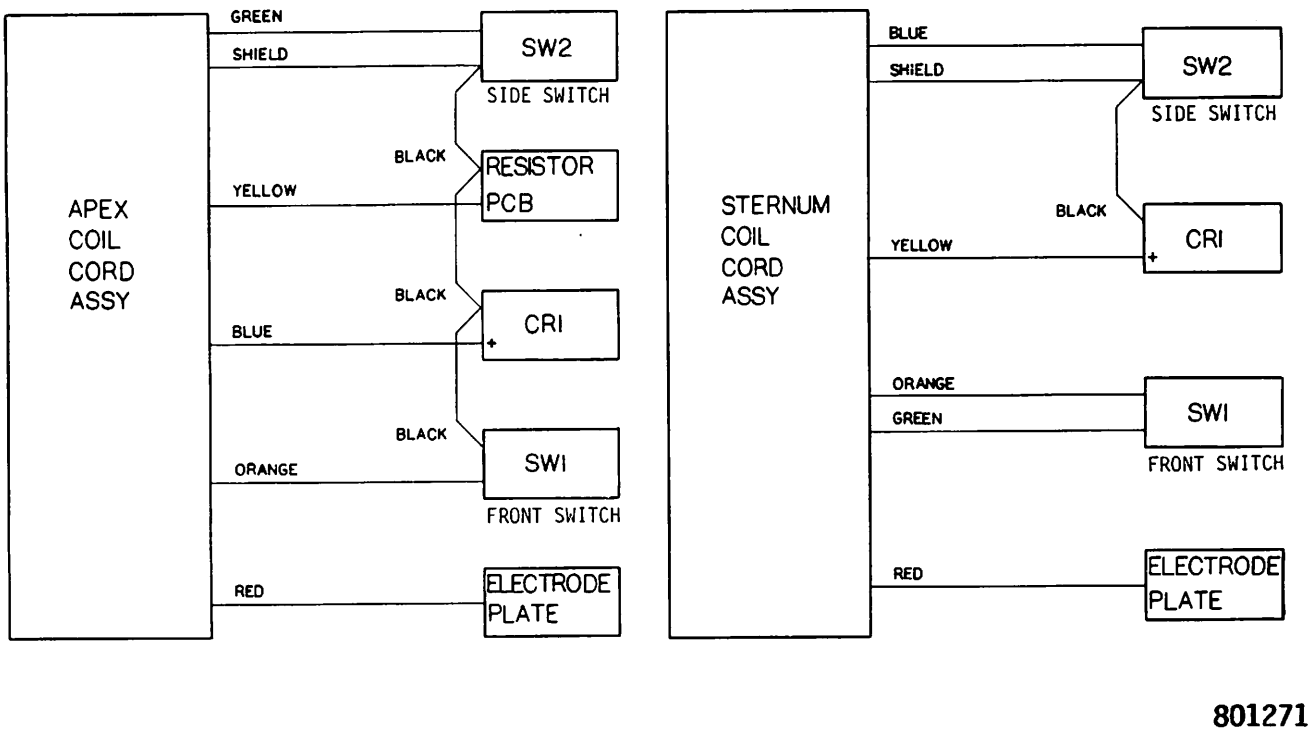


FIGURE 6-6. PADDLE WIRING DIAGRAM

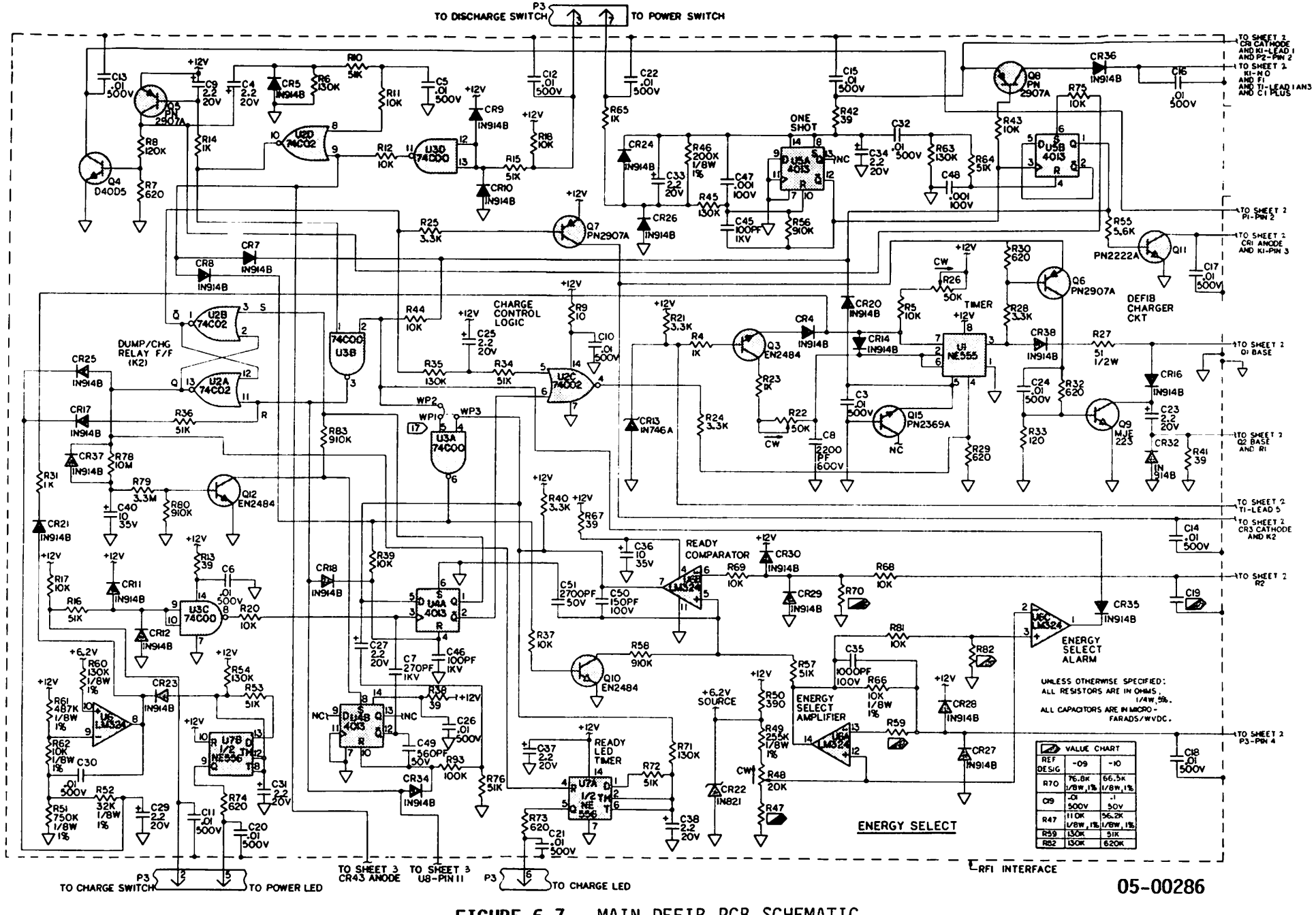
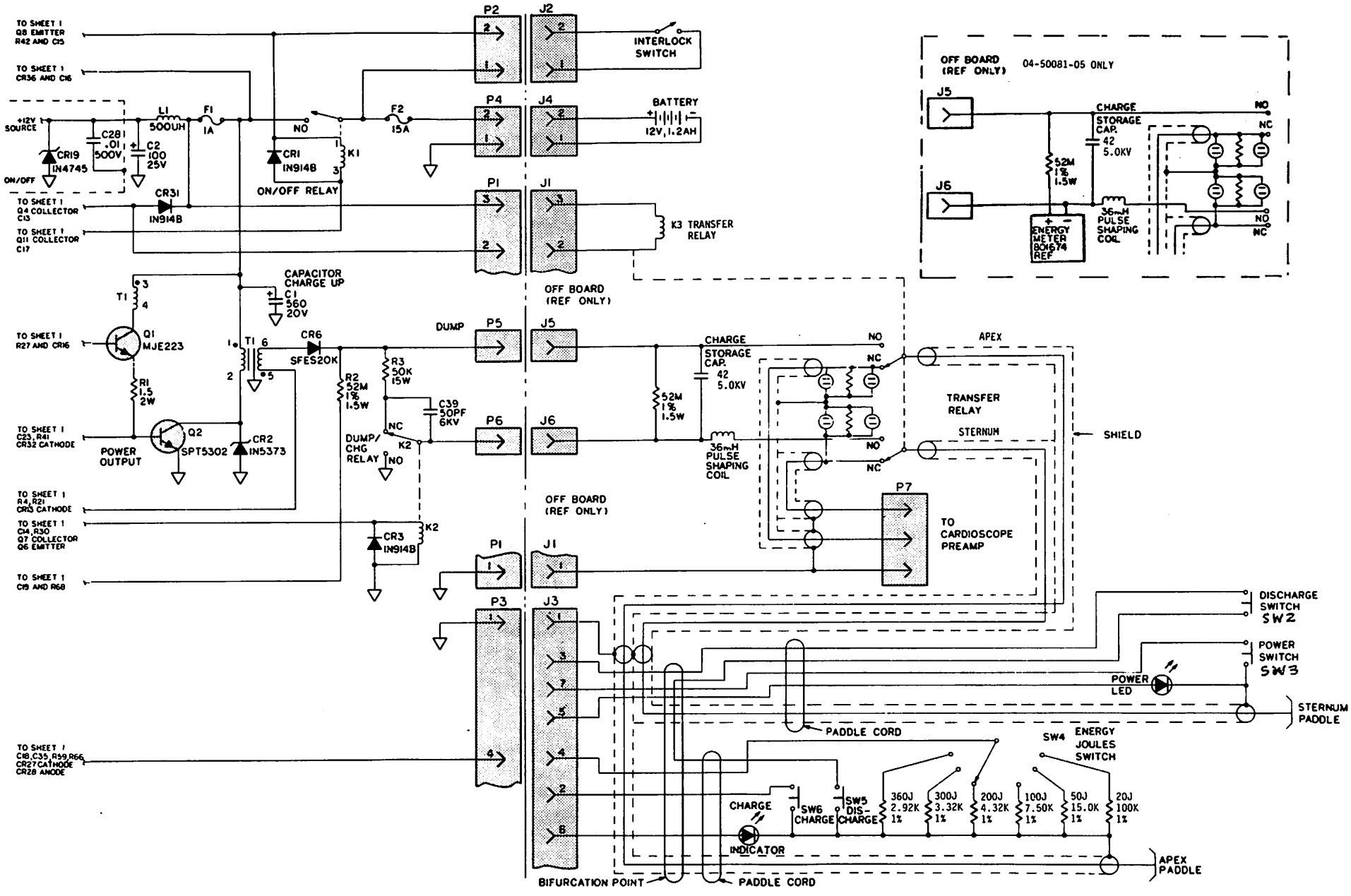

P3
TO DISCHARGE SWITCH
TO POWER SWITCH
TO SHEET 2 CR5 CATHODE AND K1-L LEAD 1 AND P2-PIN 2
TO SHEET 2 K1-NO AND F1 AND T1-LEAD 1 AN3 AND C1 PLUS
TO SHEET 2 P1-PIN 2
TO SHEET 2 CR1 ANODE AND K1-PIN 3
TO SHEET 2 Q1 BASE
TO SHEET 2 Q2 BASE AND R1
TO SHEET 2 T1-LEAD 5
TO SHEET 2 CR3 CATHODE AND K2
TO SHEET 2 R2
TO SHEET 2 P3-PIN 4
DEFIB CHARGER CKT
CHARGE CONTROL LOGIC
DUMP/CHG RELAY F/F (K2)
READY COMPARATOR
READY LED TIMER
ENERGY SELECT AMPLIFIER
ENERGY SELECT ALARM
ENERGY SELECT
ONE SHOT
TIMER
+6.2V SOURCE
UNLESS OTHERWISE SPECIFIED:
ALL RESISTORS ARE IN OHMS, 1/4W, 5%.
ALL CAPACITORS ARE IN MICRO-FARADS/WVDC.
VALUE CHART
REF DESIG | -09 | -10
R70 | 76.8K 1/8W,1% | 66.5K 1/8W,1%
C9 | .01 500V | .1 50V
R47 | 11.0K 1/8W,1% | 56.2K 1/8W,1%
R59 | 130K | 51K
R82 | 130K | 620K
P3
TO CHARGE SWITCH
TO POWER LED
TO SHEET 3 CR43 ANODE
TO SHEET 3 U8-PIN 11
P3
TO CHARGE LED
RFI INTERFACE
05-00286

FIGURE 6-7. MAIN DEFIB PCB SCHEMATIC
(SHEET 1 OF 3)



05-00286

FIGURE 6-7. MAIN DEFIB PCB SCHEMATIC
(SHEET 2 OF 3)

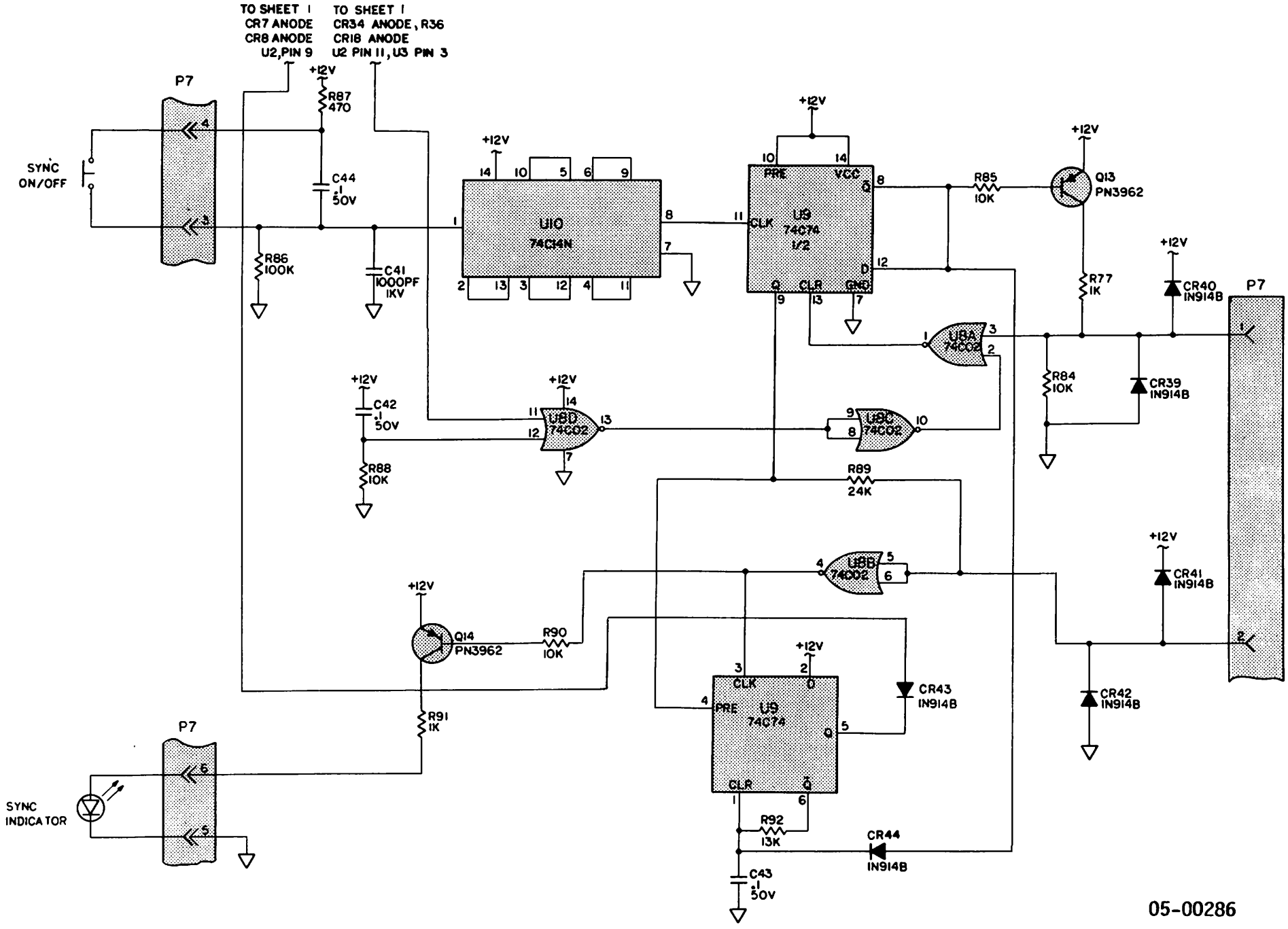


FIGURE 6-7. MAIN DEFIB PCB SCHEMATIC
(SHEET 3 OF 3)

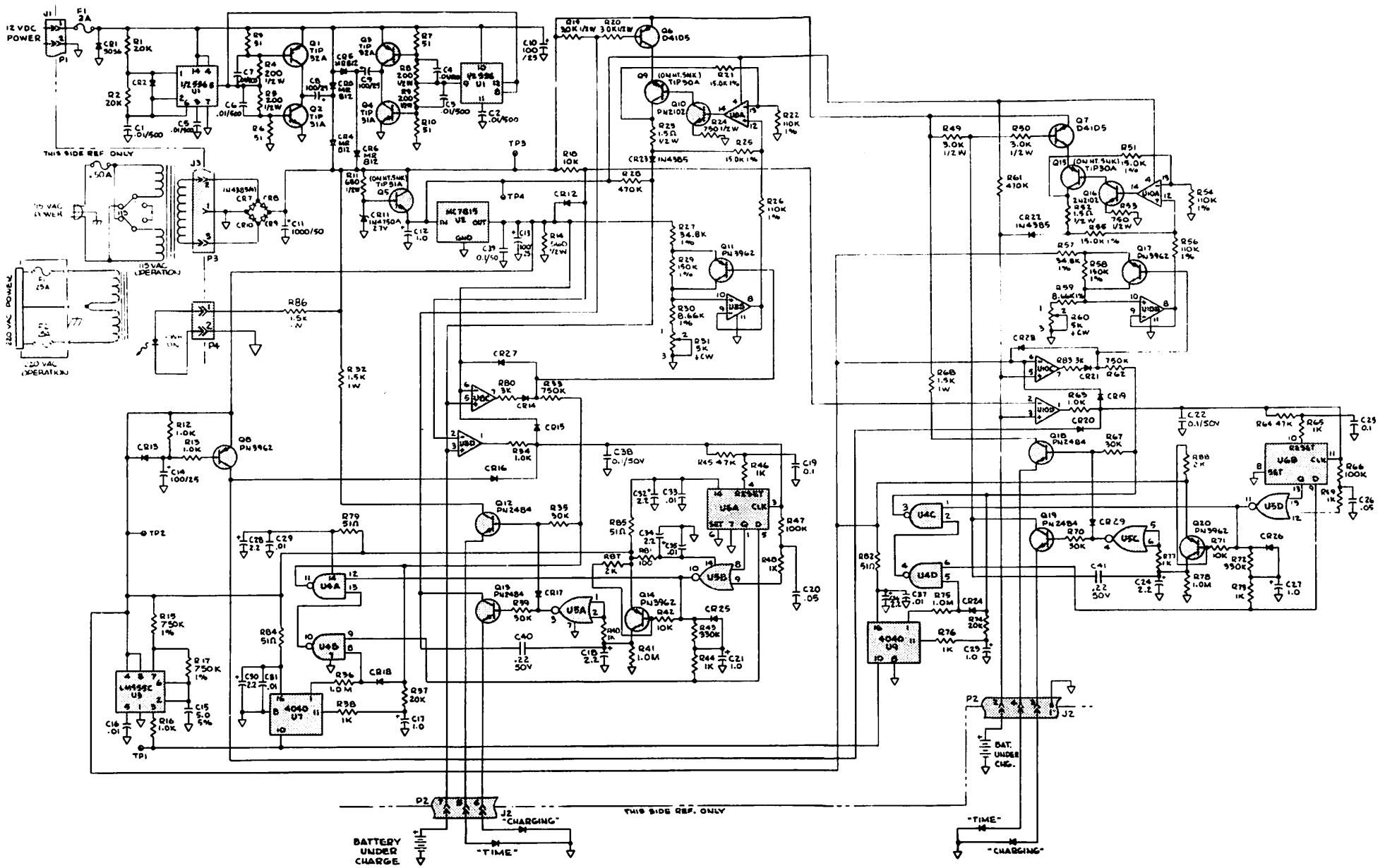
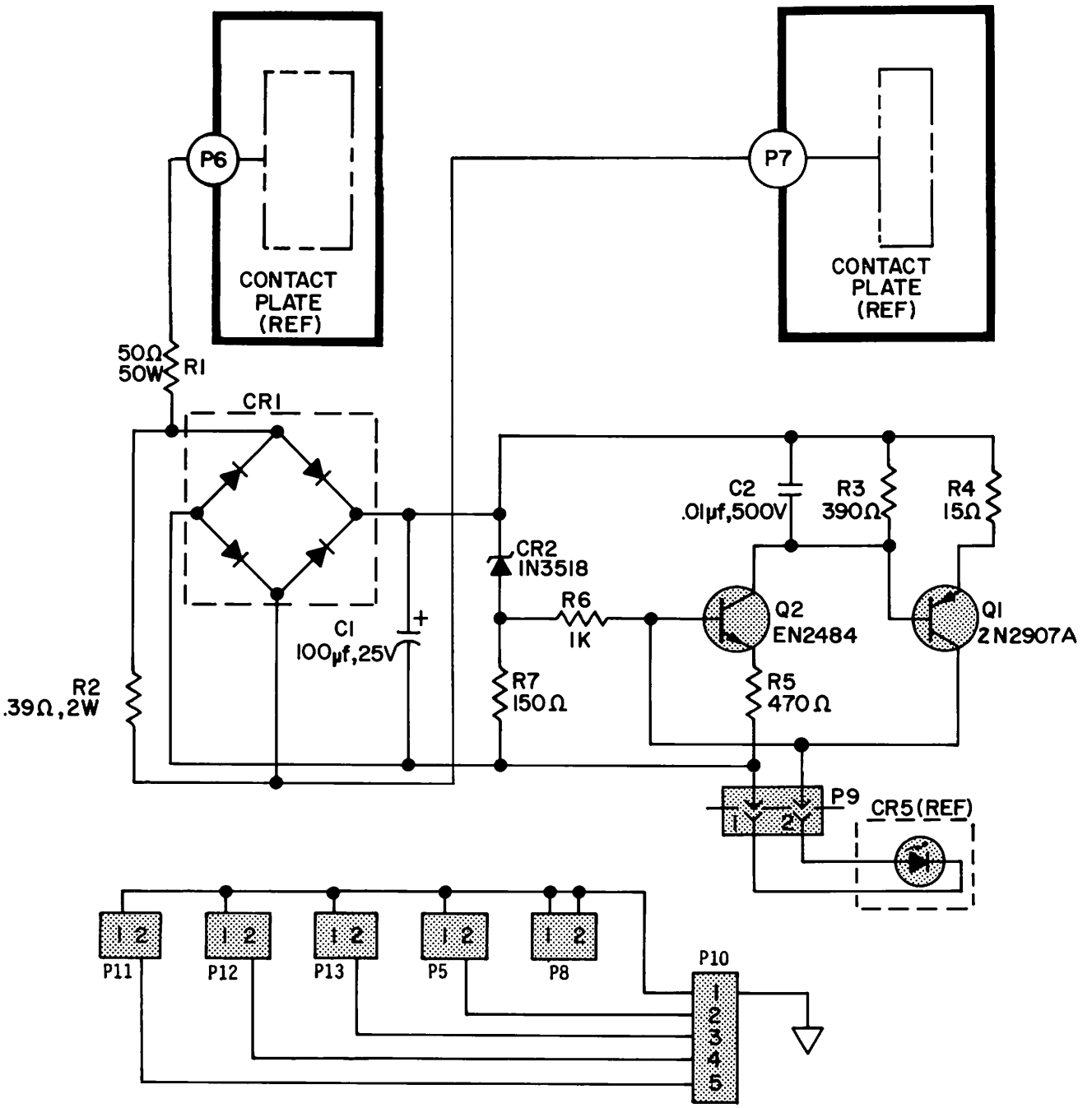


FIGURE 6-8. BATTERY CHARGER PCB SCHEMATIC



NOTES: UNLESS OTHERWISE SPECIFIED

1. ALL RESISTORS ARE IN OHMS, 1/4W, 5%, CF
2. ALL CAPACITORS ARE MFD/VDC

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FIGURE 6-9. TEST LOAD PCB SCHEMATIC